Teachers' Beliefs:
Understanding the thinking of secondary mathematics teachers as a starting point for improved professional development

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A minor dissertation submitted in partial fulfilment of the requirements for the award of the degree of Masters in Education

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April 2015

Declaration

This work has not been previously submitted in whole, or in part, for the award of any degree. It is my own work. Each significant contribution to, and quotation in, this dissertation from the work, or works, of other people has been attributed, and has been cited and referenced.

Signature: _____ Date: _____

“(W)e cannot choose that which
we do not believe to be better.”

–*Jean-Paul Sartre* (1948)

Abstract

This thesis explores the beliefs of mathematics teachers working in a rural school in South Africa. This is premised on the argument that understanding the beliefs of teachers is a necessary, even if insufficient, prerequisite to designing effective teacher development programmes. I postulate that take-up rates of new content and teaching methods are low due to unmanaged cognitive conflict with pre-existing beliefs about the nature of teaching.

A broad review of the literature on beliefs as a concept is conducted to establish theoretical grounding for the study of beliefs as an abstract object of analysis (Green, 1971; Nespor, 1987; Pajares, 1992). I particularly refer to Ernest's (1989) models of mathematics epistemology, and Adler's (2001) dilemmas of teaching mathematics in multilingual classrooms. Multiple studies of mathematics teachers' beliefs are drawn upon to relate beliefs to classroom practice.

Qualitative data on two mathematics teachers working in a rural school in the Eastern Cape was gathered over the period of a month, using ethnographic methods as outlined by Thompson (1992) for gathering evidence of beliefs. Primary data, which consisted of pre-interviews, multiple lesson observations and stimulated-recall post-interviews, was analysed for evidence of teacher beliefs. Secondary data, in the form of a researcher journal and socio-economic information about the school, was also gathered to provide rich context data in which to situate the teachers' work. Particular attention was paid to teacher beliefs about teaching and learning, mathematics and language. Further evidence for beliefs was then obtained through close examination of an observation extract using classroom discourse analysis.

The main finding of this thesis was that not only does a school's context provide logistical constraints to curriculum implementation and pedagogical change, but that the worldviews of teachers affect their interpretation of the curriculum (Chapman, 2002). Significantly, a relationship between the mathematics epistemology a teacher holds and their ability to admit language as a critical pedagogical factor is suggested. I conclude that detailed understanding of what teachers believe may provide a productive approach for teacher development programmes that aim to effect change.

Keywords

beliefs

belief systems

teacher development

teacher training

mathematics

language

teacher beliefs

rural

secondary school

qualitative

Xhosa

classroom discourse

subjectivity

Anonymity in this study

All participants in this research have done so on the condition of anonymity. The names and locations have been altered to pseudonyms to protect their privacy.

Acknowledgements

Although this thesis is only a minor dissertation, it has proven a major challenge over the last three years. Many people deserve thanks and acknowledgement for their support through what has been a difficult personal journey.

Firstly, to my supervisor, Professor Moragh Paxton, goes my utter gratitude for her patience and willingness to go way beyond her own research interests to allow me to pursue mine. You have been a steady anchor throughout this study: thank you for walking with me.

To the teachers who gave of their time and patience to work with me at Biko Secondary: ndiyabulela ngobubele benu. Enkosi.

To the David and Elaine Potter, for granting me the scholarship that enabled this study. This has been a life-altering experience and I thank you for the opportunity.

To Anna and Jenna: for support, hugs and encouragement near; to Liz and Cat, from afar (who knew study groups could span three countries?). Thank you all for your unwavering belief that I could finish this, even when I felt I couldn't.

To my mother, whose constant offers of support and tolerance of working evenings, weekends and delayed visits stood fast. Thank you for doing everything you could.

To my wonderful husband, familiar as you are with the grind of the academic process: words fail to express my thankfulness to you for your patience, gentleness and kindness, and for the space you created for me physically, emotionally and financially to find the time to finish my degree. This is as much your achievement as mine.

Lastly, to my late father who did not live to see this work complete: you always believed in me until the last—that's the belief that matters most. You are much loved and missed.

List of acronyms and abbreviations

LoLT Language of Teaching and Learning

CAPS the South African National Curriculum and Assessment Policy Statement

OBE Outcomes Based Education

DBE Department of Basic Education

DET the apartheid-era Department of Education and Training

ELL English Language Learner

ANA Annual National Assessment

C2005 Curriculum 2005

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Chapter 1: Introduction

Research Aim and Motivation

This thesis is, at its heart, a proposal for a different way of thinking about teacher development programmes in South Africa, and the information required to enhance the efficacy of these programmes.

It is my contention that effective teacher development programmes, for either new or existing teachers, must be sensitive not only to teachers' working conditions, but just as importantly, *their socio-cognitive positions*, that is, what they hold to be true in the world i.e. their beliefs. The failure of teacher intervention programmes to take into account what teachers *already* believe may go some way to explaining the mixed results of professional teacher development programmes in changing classroom practice (e.g. see Brodie, Lelliott, & Davis (2002), Reed, Davis, & Nyabanyaba (2002), and Graven (2005)).

The examination of beliefs in educational literature is well established, although not in the South African context. The choice of beliefs as an object of analysis stems from a desire to concurrently locate the individual's choices under the influence of forces enacted within social systems, and also to locate the locus of agency—the source of change—when the individual accepts or rejects the status quo established by those systemic structures i.e. whether she believes those truths held by others, or rejects them (Green, 1971).

Beliefs represent the interface between the individual and the social. As succinctly put by Philipp:

> "(T)he way one makes sense of his/her world not only defines that person for the world but also defines the world for that person. Beliefs might be thought of as lenses through which one looks when interpreting the world, and affect might be thought of as a disposition or tendency one takes toward some aspect of his or her world; as such, the beliefs and affect one holds sure affect the way one interacts with his or her world".
>
> (Philipp, 2007, pp. 257-258)

The study of teachers' beliefs, fraught as it is with methodological difficulties, still holds promise for understanding the complexity and messiness of teachers' work (Nespor, 1987). There is much evidence that teacher beliefs influence, and are influenced by, teacher practice, for example Aguirre and Speer (2000), Love and Kruger (2005), Walker et. al. (2012), and Richardson (1996). Changing beliefs, then, is perhaps a necessary (even if insufficient) prerequisite for changing classroom practice. Green (The Activities of Teaching, 1971) presents a convincing case that *the act of teaching is the act of attempting to entice another to change their beliefs about the world*. Surely then, teaching *teachers* must necessarily involve the work of enticing teachers, new or experienced, into changing their beliefs.

Cooney, Shealy and Arvold (1998, p. 306) point out that "beliefs seldom change dramatically without significant intervention". They argue that teachers do not develop and grow without the opportunity to change their beliefs, and that such opportunities must be part of teacher development programmes:

> "Thus, although we decry the randomness of our effect on teachers who participate in our teacher education programs, such randomness should be expected until we begin to understand the linkages between our activities in teacher education and the impact of activities on teachers' belief systems." (Cooney, Shealy, & Arvold, 1998, p. 331)

There seems to be very little literature on the use of beliefs as an explicit approach in South African teacher development. Adler (2002, p. 27) stated that "teachers' actions and reflections are shaped by what they *believe* to be in the interests of their learners" (my emphasis), but beliefs as a construct and unit of analysis have largely been ignored.

What follows is the description of a small qualitative study in which the beliefs—espoused and enacted—of two teachers working in a rural South African school are examined in rich detail. The data gathered is then presented and analysed, aiming to foreground how such an approach might shed a different light on understanding teachers' motivations and thinking.

The National Education Context

Volumes have been written on the complex and somewhat tragic history of the formal[1] South African education system: it is beyond the scope of this analysis to provide an in depth account of this chapter of our collective past. A somewhat superficial account is provided here to give the reader a sense of perspective on this study, highlighting those aspects of colonial and apartheid education policy and practice which are particularly pertinent to the teachers involved in this study.

Up to, and including, apartheid

The design of separate education systems for people of different races pre-dates apartheid and can be traced back to early Dutch settlers in the 17th century (Hlatshwayo, 2000). The education afforded to any persons not classified as "European" or "white" was deliberately inferior and intended to produce subservience and docility (Hlatshwayo, 2000; Kallaway, 2002). The British Governor of the Cape Colony in the mid-19th century, one infamous Sir George Grey, was more explicit about this approach: he planned to "subsidise missions training Bantu youth in industrial occupations to fit them to act as interpreters, evangelists and school masters among their own people", as "education was to be a potent instrument of subjugating the indigenous population" (Grey quoted in Hlatshwayo (2000, p. 31)). Up until the Eiselen Report of 1951 and subsequent first Bantu Education Act of 1953, teacher training for any teachers bar those of European decent was on-the-job in missionary schools[2] (Welch, 2002), and provision for 'native' education far inferior to that provided for European education. Jabavu (1921) describes the stark contrast at the time:

"The present condition of native education… is one of chaos. Natives here have a just grievance. They see government spending lavishly in putting up majestic educational edifices for European primary, secondary and university education staffed by highly paid teachers, while they have to be satisfied with having their children taught in mission rooms

[1] 'Formal' only insofar as originating from Western settlers. Much is yet to be understood about the educational systems and practices of the indigenous people of South Africa prior to colonial times.

[2] The intentions of the mission schools should not be assumed to be benevolent: as the Christian National Express, the official mouthpiece for Lovedale Missionary School, stated in 1878: "Here, then, was the most fundamental reason for educating the 'native' people—to prepare them for work, using religion as a rationale." (Hlatshwayo, 2000)

with walls dilapidated and furniture rough and scanty, teachers receiving miserable pittances, so miserable that a raw illiterate Zulu policeman in Durban today gets better pay than the best paid Zulu school teacher. Provincial grants to Native education are very tiny by comparison with those for white schools and infinitesimal as compared with the enormous revenues derived from Native taxation." (Jabavu, 1921, pp. 12-13)

The Nationalist government that came to power in the early 1950s brought the policies of apartheid and, with it, Bantu Education, all of which only further entrenched the situation Jabavu describes above. All educational activity was brought under the mantle of the exacting and authoritarian apartheid state, and funding for schools under the new "Department of Education and Training" (DET) was pegged at pre-1950 levels (Kallaway, 2002). Many 'black' students were forced into schooling in the old homelands, areas designated by the Nationalists as spaces where indigenous people could own land and trade. All labour and movement outside of these spaces, including schooling, required passes and was heavily policed and restricted (Cross and Chisholm, 1990).

Teacher training for schools that fell under the apartheid DET was brought under control of the state through the building of teacher training colleges which provided vastly inferior training to their white counterparts (Welch, 2002), along with refusal to recognise qualifications obtained elsewhere. The scope for upward mobility for black professionals within the system was limited to obtaining further qualifications as teachers, a pay-incentivised attempt to reduce the number of unqualified and under-qualified teachers working in schools[3]. However, many of these courses did not address classroom practice, and often took teachers out of their classrooms during school time for study purposes (Welch, 2002). This resulted in inflated salary costs without necessarily improved outcomes. It had other knock-on effects: the 1995 National Teacher Education Audit found that up to 95% of provincial education budgets were allocated to teacher salaries, resulting in infrastructural degradation and poor quality local teacher development programmes (Hofmeyr & Hall, 1996)—a problem that persists to this day.

[3] In 1974, 15,57% of black teachers had no matric, no technical qualification or professional qualification; 46,25% had a junior certificate and a teachers 'qualification' even though they had not matriculated (completed the full 12 years of primary and secondary education); 11% had a matriculation, and only 1,69% had a university degree, albeit from a 'black' university (Hlatshwayo, 2000).

Language

Another important aspect of the apartheid-era education policy was the language of learning and teaching (LoLT) in schools. Much of the social and political upheaval of the 1980s was catalysed by the 1976 Second Bantu Education Act: a policy designed to further entrench separate and unequal education through the use of mother-tongue instruction, thereby denying black South Africans opportunity to master the language(s) of the formal economy, English and Afrikaans. For many black South Africans, access to English is synonymous with access to education, a position entrenched by apartheid-era policy as well as the hegemony of English in the South African formal economy (de Wet, 2002; Alexander, 1999). As a result, most schools opt to switch from home language instruction to English as their LoLT from grade 4 (age 10) onwards.

However, for the vast majority of South Africa's black students attending urban and rural ex-DET schools, English is not their first, or even second, language[4]. Setati (2008) distinguishes between the language environments of urban and rural South African schools: for the former, English is an additional language, accessible outside of the classroom in a myriad of forms; whereas for the latter (particularly the ex-homeland areas), English is effectively a foreign language, neither seen nor heard outside of the school environment. The challenges each environment poses to teachers are distinct.

Home language and attainment levels in formal schooling are closely correlated, particularly in mathematics (Simkins and Paterson, 2005), and language continues to pose one of the greatest challenges in the education of South African students and the development of the teaching corps (Adler, 2002, 2001, 1998; Alexander, 1999; Probyn, 2001; Setati, 2008; Setati, Adler, Reed and Bapoo, 2002).

[4] According to the most recent population census (Stats SA, 2011), only 9.6% of South Africans speak English as a first language, compared to Zulu at 22.7%, Xhosa at 16% and Afrikaans at 13.5%.

Post-apartheid: the picture today

The legacy of the past 400 years of deliberately unequal educational provision presents itself as a system-in-crisis which has increasingly occupied the space of public debate in South Africa in recent years. Teacher subject knowledge continues to be a challenge (Taylor and Vinjevold, 1999), as is: the production of sufficient new teachers (Welch, 2002)—and as a result, class size; teacher absenteeism (Reddy et. al., 2010); school infrastructure (Department of Basic Education, 2009); student retention in the system (Department of Basic Education, 2011); and the general quality of what teaching and learning does happen when classrooms are functioning as intended. Unsurprisingly, student attainment on large-scale quantitative tests has been poor (Howie, 2005). These challenges are predominantly concentrated in ex-DET schools that serve the poorest students—with all the concomitant socio-economic challenges that poverty brings to education (Fleisch, 2008). As a result the South African education system continues to perpetuate and entrench along racial lines the gross economic inequality that has characterised the country since its recognition as a nation-state.

Many teachers operating in ex-DET schools are themselves recipients of Bantu Education, especially in the ex-homeland areas. Attempts to 'shore up' the lack of quality teaching capacity have resulted in 3 new national curricula since the end of apartheid 20 years ago. The first of these was Curriculum 2005 (C2005), a very open-ended student-centred pedagogic framework which, while noble in its intentions, was poorly implemented and not viable with the resources of the time. Training on C2005 often consisted of once-off workshops conducted by local education authorities (Rogan, 2007), with very little in-school support. In his address entitled "Dilemmas of public education policy in contemporary SA", Peter Kallaway stated that teachers are "unable to execute the task in a manner which earns the respect of students", and hence are forced to use corporal punishment (now outlawed) to maintain order in vastly over-crowded classrooms. He continues:

> "(T)o make matters immeasurably worse, the new curriculum (C2005) did away with the very structure that would have given the majority of our modestly trained teachers a raft to cling to—namely the textbook knowledge that was the major aspect of their own training as teachers."
>
> (Kallaway, 2009, p. 2)

Despite a second major revision in the form of the Revised National Curriculum Statement in 2008, C2005 and its outcomes-based focus was abandoned in favour of the new Curriculum and Assessment Policy Statement (CAPS), the implementation of which was completed in 2014 across all grades. CAPS has swung the pendulum in the complete opposite direction to the reform-based C2005, prescribing what content is to be taught (and when) down to individual lessons: an attempt to hedge against what is perceived as teacher inability to plan and execute a more open-ended curriculum.

Kallaway argued that, for the vast majority of teachers who found themselves in poorly resourced, struggling schools, the result of the constant curriculum churn was "a defensive stance that exhibited itself in a perpetual stand-off with education officials, who themselves only had a tenuous grasp of what was required" (Kallaway, 2009, p. 3), a situation confirmed recently by the Department of Basic Education (2013). This defensive stance is further exacerbated by a highly unionised teaching corps, developed in response to the apartheid education system and the "bureaucratic, hierarchical and authoritarian" conditions it oversaw in black schools (Chisholm, 1999, p. 115).

To further compound matters, English is many schools' official LoLT, but is only taught as a second language (Kapp and Arend, 2011): where students and teachers share a common language, code-switching is common.

It is against this backdrop of interconnected challenges that I now turn to examine some more specific issues regarding teacher development in South Africa.

The challenge of teacher development and how analysing beliefs may help

In their meta-analysis of research into mathematics and science teacher development in South Africa, Adler et. al. admit that "those involved in teacher education continue to struggle with what kinds of support teachers can and should be offered." (Adler, Pournara, Gundry, Thorne, and Moletsane, 2009, p. 1). Adler (2002) and Graven (2005) both outline the constant dilemmas inherent in teacher development programmes: between theory and practice; content knowledge and pedagogical instruction; as well as constrained resources and time available. The closing of the apartheid era teacher training colleges effectively reduced the number of tertiary institutions training teachers from 150 to 23 (Welch, 2002). This made longer school-based teacher development initiatives far more difficult to enact, even though they are known to be more productive (Adler, 2002; Graven, 2005, 1997; Rogan, 2007). Furthermore, teacher development programmes find themselves needing to cater for teaching candidates with "less than satisfactory schooling backgrounds" as they receive applicants from schools that are struggling to deliver quality learning experiences (Department of Basic Education, 2005).

In such situations, it is easy to fall into the temptation of using deficit discourses. Adler (2002) rightly warns against this, suggesting rather the use of a 'language of dilemmas' to expose and problematize the complexity and messiness of evaluating both teachers and their choices. I contend that studying these teachers' *beliefs* could assist in addressing this challenge by taking up Green's position:

> "Beliefs, after all, cannot be assessed in ignorance. *They cannot be assessed until it is understood why men who have held them found them reasonable*. And that cannot be done until a great deal is learned."
>
> (Green, 1971, p. 106)(my emphasis)

Adler (2002) claimed that very little research has been done on what teachers actually 'take-up' from professional development programmes. Subsequently, Adler et. al. (2009) have reiterated that little research has been done on these programmes. They claim that South African researchers need to know more about:

> - "ways of offering and inducting teachers into new experiences of teaching, to broaden their pedagogical imagination**;**
> - productive ways of providing teachers with conceptual tools for engaging current and future curricula in ways that they find the discourse of curricula meaningful; and
> - the difficulties teachers face in their attempts to implement new curriculum policy in mathematics and science and how teacher education might address this."
>
> (Adler, Pournara, Gundry, Thorne, & Moletsane, 2009, p. 2)

How might the study of beliefs in response to Adler et. al's challenges assist in improving teaching and learning? In a large scale quantitative study into factors affecting students' mathematics attainment in South Africa, Howie (2005) identified 6 classroom-based variables that explained 44% of total variance in student mathematics scores: teaching load, **teachers' background**, resources, class size, **teachers' beliefs** and **teachers' attitudes**. She writes:

> "The results indicate teachers' attitudes and beliefs contribute most significantly to the explanation of the variance in mathematics achievement at classroom level." (Howie, 2005, p. 129)

Given Adler et. al.'s identification of the gaps in teacher development research, and Howie's findings on factors that affect student attainment, it seems a logical next step to explore teachers' beliefs as a mechanism to improve teacher development programmes, and hopefully the quality of teaching and learning in schools as a result.

Research Question

Having identified the critical role that beliefs could play in effective teacher development, the focus of this thesis is thus to establish: what do secondary mathematics teachers working in a rural South African school *believe*? What do they believe about their work? Their subject (mathematics)? Their context? Their challenges relating to language? How do their espoused beliefs manifest in their teaching practice, and how does their practice inform their beliefs? These questions are pursued with the intention of improving teacher development.

The village of Makhaya, Biko Secondary School, its teachers and students

50% of South Africans live in rural areas (Howie, 2005) similar to the village of Makhaya where this study took place. The village lies approximately 100km from the nearest metropolitan centre in one of the former homelands in the Eastern Cape, and 20km via an extremely poor-quality road from the local town where supplies can be obtained. Most of the 892 residents of Makhaya (Stats SA, 2011) do not own private vehicles and rely on informal shared transport to leave the valley where Makhaya lies in the mountains. Homes in the village have electricity, but water access is from communal street taps or rain water collected from domestic run-off. Municipal sanitation services do not reach the community, with household refuse being recycled or burnt, and each homestead builds its own pit latrines.

The population demographics of Makhaya are visibly bimodal: there is a distinct absence of men and women between the ages of 25 and 50, with the village mainly inhabited by children of school going age and the elderly. This is significant for the learning ambitions of Makhaya's children: of the 1 122 000 people in South Africa above the age of 15 years estimated to be unable to write their name, 816 000 of them are above the age of 50 (Stats SA, 2011). Anecdotal discussion with the teachers and villagers indicated a low literacy rate amongst the elderly residents who are the students of Biko Secondary School's primary caregivers.

Subsistence farming is a common practice in Makhaya, although at insufficient levels to fulfil most villagers' food requirements. HIV is apparently widespread, as is diabetes[5], with many villagers depending on state pensions, disability grants and child-support grants issued by the government for survival. The village also has a small tourism project, which attempts to leverage the local environment as an eco-tourism attraction, and some communal farming programmes, but it is unclear whether the benefits of these are reaching the majority of the villagers.

[5] This was ascertained through an informal conversation with the village nursing sister at the local clinic.

Biko Secondary School

According to Census 2011 (Stats SA, 2011), 93,62% of the people in Makhaya's district speak Xhosa, but the official medium of instruction at Biko Secondary School, the only high school serving Makhaya and the surrounding villages, is English. All school-leaving exams are written in English, and all textbooks and DBE workbooks are provided in English. In this regard, Biko Secondary is in a position similar to most rural schools in the Eastern Cape and around the country, officially teaching in what is effectively a foreign language (Setati, 2008), but needing to adjust to the local constraints by code-switching within lessons.

The school was relatively well-resourced, however, in the quality of its infrastructure. It had solid brick classrooms, a new library recently built, adequate office space for staff—equipped with one or two (admittedly ageing) computers and a printer—a functioning photocopier, and a relatively new donation of laptops from a local NGO for student use. Ablution facilities still consisted of pit latrines for both staff and students.

Also notable at Biko Secondary was the low student-teacher ratio, atypical in rural public Eastern Cape schools, which are notorious for large, over-crowded classes. There were approximately 120 students enrolled at Biko Secondary with 10 full-time teachers, a secretary, principal and caretaker. Teachers' teaching loads were far below full, with each teacher on average having two lessons free out of six total scheduled lessons per school day[6,7].

The students at Biko Secondary

All the students at Biko Secondary would fall into the apartheid-era classification of 'black African'. Most were older than the correct age-cohort for their grade. This was primarily due to repeating years in the earlier phases of schooling, or missing out a year of schooling due to pregnancy or family-related responsibilities.

[6] This situation had arisen, according to the Principal, from the exodus of students to urban areas once their parents had found gainful employment, combined with the unwillingness of the DBE to compensate teachers to move location to schools where staff numbers were low, resulting in teachers refusing to move schools. This has led to some schools, like Biko Secondary, being overstaffed, while others remain chronically understaffed.

[7] Given the variables 'resources' and 'class size' mentioned earlier in Howie (2005), this arrangement made Biko Secondary unusually ideal for investigating teacher beliefs, since despite good resources, its mathematics scores were average.

As a result, student age varied widely within classes:

	Grade 8	Grade 9	Grade 10
n	27	16	23
Mean age	15,56	16,44	17,78
Modal age	14	16	18
Oldest student	19	18	21
Youngest student	14	14	16

Table 1: Student age distributed across Grades 8, 9 and 10 at Biko Secondary School.

Students' anonymous self-assessment of their language capabilities showed, unsurprisingly, they were far more confident in their oral language proficiency than their written, and more confident in Xhosa compared to English, making academic learning in English a real challenge.

	Xhosa	English
Spoken	3,62	2,10
Written	2,66	1,78

Table 2: Average of students' self-assessment of language proficiency on a scale of 1 to 4 (1 = weak, 4 = strong) (n=74)

Of the 74 respondents, 21 declined to give their previous year's mathematics mark. Of the remaining 53, the average score was 59,8%. However, it is likely this mark is not reflective of students understanding of the curriculum, as the assessments for these grades are set internally within the school. Unfortunately, Grade 9s were not yet being assessed nationally in 2011. In 2012, however, the district of the Eastern Cape under which Biko Secondary School falls, scored an average of 11,3% for Grade 9 mathematics in the Annual National Assessments (ANAs) (Department of Basic Education, 2012)[8].

Biko Secondary was able to offer its students the option of pure mathematics or mathematical literacy for their school-leaving examinations because of its high staff numbers. Only 10 out of 28 matriculants had chosen pure mathematics as a subject in Grade 12 (final year) in 2011. Of these 10, only 1 passed[9].

[8] ANAs are annual benchmark tests set in mathematics and language that are issued across all public schools nationally in South Africa.
[9] a pass mark at this stage requires a 40% aggregate or more.

The teachers at Biko Secondary

The teaching staff consisted of ten teachers and one principal who occasionally taught English lessons. The principal, one teacher, and the caretaker were male, with all other staff members being female. Only one of the ten teachers resided in Makhaya. The principal and the other nine teachers stayed in satellite towns around the district urban centre and commuted to work each day. The teachers shared transport from one such town, Kwabantu, 20km outside of Makhaya, to save costs, hiring a driver and his van to travel the poor quality road (a journey of approximately one hour in dry weather). Some teachers were making a longer journey, catching public transport from the main urban centre to Kwabantu each day—a total return trip in excess of 100km. This, unfortunately, meant that should one teacher arrive late to make the connection in Kwabantu, then all arrived late. Attending workshops or department meetings outside of Makhaya was highly disruptive to schooling due to the extensive travelling time.

Three teachers at Biko Secondary taught mathematics at various levels. Initially the study covered all three, but the third teacher (who taught Grade 8) was not a specialist mathematics teacher and it was decided that closely examining her teaching practice would not be fair or productive[10]. The other two, Zolani and Thandiswa, both live in Kwabantu and commute into Makhaya each day. Thandiswa taught Grade 9 mathematics and Grade 11 and 12 maths literacy. Zolani taught Grade 10, 11 and 12 mathematics. Since Biko Secondary has only one class per grade, both teachers filled in with other subjects, although maths was their primary focus.

Detailed descriptions of both Zolani and Thandiswa's experiences of schooling, as well as their training and work experience as teachers, are critical to understanding their beliefs, and thus are presented as part of the analysis in this study. Their biographies are covered in more detail in Chapter 4.

[10] It should be noted, however, that many schools in rural areas have teachers teaching subjects which are not their specialty, due to changing subject demands, falling student numbers or subject specialists simply not being available.

Conclusion

Biko Secondary in the village of Makhaya is, in many respects, a very typical South African rural school that bears a heavy burden of past inequities and social injustice. Its teachers, students and their families continue to battle the socio-economic challenges imposed upon them by apartheid, facing language dilemmas and poor student attainment in their school.

This study is the story of two teachers' beliefs, Zolani and Thandiswa, at Biko Secondary, in an attempt to shed light on their work and their world. In doing so, I hope to expose new approaches to praxis that may assist teachers like Zolani and Thandiswa, and the teacher development programmes that seek to serve them.

The next chapter will look at the theoretical concept of 'beliefs' in more detail, giving an overview of the theoretical literature and arriving at a working definition for the purposes of this research. It also provides a brief overview of other studies that have addressed teacher beliefs.

Chapter 3 outlines the methodology used, and also addresses issues of positionality and validity pertinent to the findings obtained. A rationale for using classroom discourse analysis as an analytical lens to examine beliefs will also be presented. Chapter 4 constructs rich belief 'portraits' for the two teachers involved based primarily on their interviews, and Chapter 5 seeks to provide further evidence for the beliefs attributed to them by examining an extract from one of their lessons. Finally, Chapter 6 proposes how the information obtained through such portraits might be relevant to the design of teacher development interventions and training, concluding with recommendations for further research.

Chapter 2: Conceptual Framework

Beliefs are a difficult, abstract concept to work with and warrant some careful theorizing and discussion. The concept 'beliefs' can be taken to imply affect, attitudes, motivation, knowledge and values (McLeod, 1992; Philipp, 2007; Thompson, 1992), and segues between the psychological and the sociological, the cognitive and the collective (Calderhead, 1996).

The following chapter deals with various conceptions of beliefs presented in the education literature, culminating in the definition used for this study. Thereafter, problems for operationalization and measurement are discussed, along with the appropriateness of understanding beliefs as a means to improve teaching practice. Finally, a brief overview of other studies on teacher beliefs are summarised.

Introduction to beliefs

An attempt to comb the literature for insight into what beliefs *are*, turns up multiple—often conflicting—descriptions and definitions, with the only consensus being that there is no consensus (Nespor, 1987; Pehkonen & Pietilä, 2003; Philipp, 2007; Törner, 2002). However, as Thompson (1992) and Philipp (2007) both pointed out in their meta-analyses of the research done on mathematics teachers' beliefs, in the absence of consensus on a definition, the most important task that presents itself to the researcher is not synthesis of all available definitions, but the declaration of a specific, operational definition for the purpose of the study at hand. As noted by John Stuart Mill (1898), defining a concept with which one is grappling can only happen *after* discussion and deliberation; hence a selection of definitions and properties of beliefs from various seminal texts are provided here for depth, arriving at a final description for the purpose of this thesis.

What are beliefs?

Beliefs are often intertwined with other concepts—most notably knowledge, values, attitudes and feelings. It is the distinction between these that causes the difficulty in defining beliefs for research purposes.

Certainly it is easy to identify that there is variety amongst the numerous objects we might refer to as 'beliefs', simply by examining the way we use language when stating them. Take, for example, Philipp's (2007) distinction in the statements "I believe that…", compared to "I believe in…": the use of the preposition denotes, in his opinion, the difference between a cognitive, propositional belief and a value. Richardson stated that beliefs are "psychologically held understandings, premises or propositions about the world that are felt to be true" (Richardson, 1996, p. 103); a reasonable definition if one regards beliefs as solely about knowledge, but not satisfactory when considering those beliefs that are affective (i.e. based on emotions or feelings). Having said which, even affect in the form of attitudes and emotions can be explicated as beliefs (Peacock, 2001), for example by casting them into the sentence "I believe that… (mathematics is scary)" (although admittedly such beliefs are usually held implicitly and not scrutinized in this fashion by their holder).

To make the construct even more fraught with difficulty, what we can *say* about our views of the world is fundamentally constrained by the linguistic structures of our language (Alexander & Dochy, 1995; Bogdan, 1986; Törner, 2002): certainly a sobering challenge when studying beliefs.

For the main possible interpretations of beliefs as other concepts, a brief discussion of the literature is provided, followed by the working definition for beliefs for this study, taking this literature into account.

Beliefs as knowledge

For many, the main concern about the nature of beliefs is how they are epistemologically differentiated from knowledge (Pehkonen & Pietilä, 2003). In her review of the studies of beliefs of maths teachers up to that point, Thompson (1992) found two criteria that assisted in distinguishing knowledge from beliefs. Firstly, beliefs have the property of conviction,

whereas knowledge does not. When people recognise ideas as beliefs, they are willing to attach a 'degree of conviction' to those ideas (Törner, 2002)(also see Green (1971) below). However, 'conviction' must necessarily be 100% in the case of knowledge as it is considered fact. Secondly, beliefs do not require consensus: those ideas recognised as beliefs admit the possibility that others may disagree. Knowledge requires consensus—an idea or preposition cannot be knowledge unless we all agree that it is true (Pehkonen & Pietilä, 2003).

These criteria seemingly provide a useful checklist for any conception put forward as a 'belief'. A difficulty arises, however, when what one person considers a belief, another considers knowledge. For what is held as 'socially accepted knowledge' by one is, itself, a belief, and hence may be different for another.

Scheffler (1965, cited in Wilson & Cooney, 2002) claims that, while belief and knowledge are both cognitive constructs, belief is a weaker construct than knowledge. He used the following logical statements to define knowledge in terms of belief:

One knows Q if:

1. one believes Q
2. one has the right to believe Q (i.e. there is evidence that warrants it)
3. Q is in fact true.

However, the third criterion poses difficulties: how can you be sure Q is true? What is thought of as true at one point may be debunked in the future for a better 'truth' (Philipp, 2007). Wilson and Cooney (2002) modified Scheffler's definition by dropping the last criterion. The remaining two criteria illustrate well how people come to 'know' their beliefs, in the absence of contradicting evidence or challenges to them. What people claim is knowledge is often reified belief, a difficult hurdle for teachers to overcome in both themselves and their students. As Nespor (1987, p. 318) stated:

> "The reification of transitory, ambiguous, conditional or abstract characteristics into stable, well-defined, absolute and concerted entities is

> important because such entities tend to be seen as immutable—as beyond the teacher's control and influence."

In summary, distinguishing between belief and knowledge is usually a function of evidence and social consensus, even where consensus can be easily reached and evidence is limited. Beliefs may behave like knowledge in the sense that they may have a cognitive component and be assigned some truth value. From a researcher's perspective, however, the ontological truth value of the actual belief is far less important compared to the perceptions of the teacher who holds it (Philipp, 2007).

Beliefs, unlike knowledge, can take on different guises not related to truth values or cognitive propositions. As Nespor described:

> "(B)elief systems often include affective feelings and evaluations, vivid memories of personal experiences, and assumptions about the existence of entities and alternative worlds, all of which are simply not open to outside evaluation or critical examination in the same sense that the components of knowledge systems are."
>
> (Nespor, 1987, p. 321)

Given this observation, we must next consider beliefs that are not propositional in nature.

Beliefs as attitudes and affect

The difference between attitudes and affect are vague in the literature, with the most common distinction being duration and stability (McLeod, 1992). Affect is the term used to describe direct and immediate emotional reactions to certain experiences, often indicating belief at a very deep level that may not even be consciously realised or articulated, and that have a short lifespan. Attitude, however, is considered a more stable disposition generated over a period of time, given a repeated affective response to a certain experience (McLeod, 1992; Philipp, 2007).

To illustrate this distinction, consider the response a student may have to a maths test if she believes mathematics to be impossibly hard, or believes herself to be a very weak maths

learner, combined with the belief that all assessments are a personal reflection on her character. Her instinctive reaction may be one of fear and anxiety; she believes mathematics to be scary, and that failure holds dire consequences for her. This type of affective belief is not a propositional statement with a verifiable 'truth' value—it is true only in her context, her world. Her actions will most likely be influenced by this belief.

Given sufficient experiences of this nature, this maths learner may develop certain *attitudes* towards mathematics, such as 'avoidance'. This would not have been her initial reaction, but rather a predisposition built up over time reflecting a pattern of experience. Her original *affective* beliefs that "maths is scary" and "failure is a personal indictment" build into a longer-term *attitudinal* belief that "maths should be avoided".

This type of belief differs markedly from beliefs that are propositional in nature. Being far more emotion-based than the cognitive belief, the criterion of 'truth' is more subjective for affective and attitudinal beliefs. This, however, should not be misconstrued as being a less powerful type of belief.

Beliefs as values

Rokeach (The Nature of Human Values, 1973) proposed that values are a type of belief. It is not difficult to imagine a belief statement that expresses value in the form of: "I believe that X is important". However, contrary to some other proposed descriptions (e.g. (Bishop, Seah, & Chin, 2003)) not *all* beliefs are values[11], even though many contain an evaluative component (Törner, 2002). Considering beliefs as values could provide valuable insights in a discursive analytic, where values are reified as knowledge: the consideration of knowledge-beliefs as value-beliefs may provide key insights into deeply held beliefs that determine courses of action in classrooms.

[11] Consider the statement "I believe that people lie". This is a cognitive statement that describes the world, and does not in any way indicate the importance attached to this by the utterer: a belief that is not a value.

Beliefs as all of these

All of the above conceptions of beliefs appear defensible. Consider the following statements:

1. "I believe mathematics is the language of describing the universe" (cognitive)
2. "I believe that mathematics is a critical component of any person's education" (value)
3. "I believe languages are easy if you try" (attitude)
4. "I believe that learning a new language is scary" (affect)
5. "I believe that learning other peoples' languages is a means of connecting with them" (value *or* cognitive)

All of these sentences are intelligible and start with the phrase "I believe". All could be mistaken as 'knowledge' by someone unwilling to entertain alternative perspectives, whereas others may recognise them as mere beliefs of individuals, up for scrutiny and without consensus.

Beliefs as systems

In his seminal book, "The Activities of Teaching", Thomas Green (1971) describes the act of teaching as fundamentally *the act of changing another person's beliefs about the world.*

His description of *belief systems* is still highly cited and bears mentioning here. Green noted that beliefs do not occur in isolation, but can be thought of as occurring in systems with specific structures and properties:

1. Beliefs occur in clusters

The first property is that beliefs occur in related clusters that can be kept relatively isolated from each other, thus enabling one person to maintain logically conflicting beliefs simultaneously without cognitive conflict.

2. Beliefs have quasi-logical ordering

Some beliefs can be thought of as predecessors to others, following a quasi-logical inference pattern. For example, the statement "I believe I will fail this maths test" will depend on the statement "I believe maths is hard" or "I believe I have not prepared adequately for this test", or both.

3. Beliefs can be central or peripheral

Independent of their quasi-logical ordering, beliefs can be held 'loosely' (what Green terms 'peripheral beliefs') and be easily abandoned or changed, or held with far more conviction ('central beliefs') and be deeply seated and perhaps even seen as immutable. This description fits in with Thompson's (1992) notion of conviction described previously.

Green's model is useful in that it encourages researchers of beliefs to reflect on each belief as connected with others (e.g. Chapman, 2002). This has implications for both measuring beliefs as well as considering what may appear to be inconsistencies in the beliefs as they initially present in a study.

Beliefs as both cognitive and sociological

Much mathematics education research finds itself positioned as either psycho-cognitive or sociological: where do beliefs fit into this dichotomy? Most of the literature described thus far is cognitive in nature: in fact, Gates (2006) critiques the heavy focus on beliefs in the mathematics education research corpus as being excessively cognitive, ignoring the sociological aspects of mathematics teaching practice. He calls for "excavating beyond espoused beliefs into dispositions and ideological tendencies." (p. 348). However, given the discussion above of what beliefs *can be*, these two positions of beliefs as cognitive and beliefs as ideological (and hence necessarily social) are not irreconcilable.

In this study, I share the position of Yackel and Rasmussen (2002): that beliefs are neither solely psychological nor solely sociological, but rather occupy the strange interface between the individual's thoughts and feelings and her surrounding world and community. Beliefs

influence, and are influenced by, action and experience[12] (Philipp, 2007) and while they can be considered to be located in the individual, are almost completely social in their origin (Green, 1971; Op 't Eynde, de Corte, & Verschaffel, 2002; Vygotsky, 1997). Gates is indeed correct that examining beliefs in isolation from the social context in which they are held and acted upon is limiting, but the concept of beliefs as I will define it here does not preclude a sociological lens.

Beliefs in this study

For the purposes of this thesis, then, beliefs will be considered as the collection of all of the above 'types' of premises and predispositions towards the world. Since the aim is to gain as much insight as possible into the thinking of the participating teachers, a looser definition will better allow a rich, qualitative analysis without imposing messy distinctions that obscure the object of analysis (Speer, 2005).

The next section outlines an argument for understanding beliefs as a means of improving teacher development, followed by a brief synopsis of other studies of mathematics teachers' beliefs.

Understanding beliefs as a means of improving teacher development

The point of researching teachers' beliefs is to "determine how teachers' knowledge, beliefs and affect relate to their instruction" (Philipp, 2007, p. 257). Examining teacher beliefs is an intellectual exercise without considering the impact and implications for practice. In the words of Thompson:

> "It is not until we have a clearer picture of how teachers modify and reorganise their beliefs in the presence of classroom demands and problems, and, conversely, how their practice is influenced by their conceptions of mathematics, that we can claim to understand the relationship between beliefs and practice." (Thompson, 1992, p. 135)

[12] Even Wittgenstein wrestled with the question, "Is Belief Experience?" (Bogdan, 1986)

An understanding of the kind Thompson encourages requires *descriptive* research in which the occurrence of certain beliefs and practices can be studied side-by-side and relationships between them postulated. The response to her call for such understanding has been vast. The literature of the last two decades contains hundreds of studies across many countries, in which the beliefs and practices of teachers (both in-service and pre-service) are described. (For a small sample of examples, see: Beswick, 2007; Calderhead 1996; de Vries, van de Grift, & Jansen, 2014; Middleton, 1999; Simon and Tzur, 1999; Tan, 2011; Walker et. al., 2012; Wenner, 2001). The large-scale study conducted by de Vries et. al (2014), while still descriptive, provides compelling evidence of the importance of beliefs in teachers' engagement with new ideas and training.

Changing beliefs

Many of these studies do not attempt to effect change in beliefs or measure the outcome. This next step has particular ramifications for teacher development. Chapman stated the case clearly when she said that:

> "(i)t has become an accepted view that it is the teacher's subjective school related knowledge that determines for the most part what happens in the classroom. Consequently, *any attempt to reform the teaching of mathematics will also require a corresponding "re-forming" of teachers' thinking as a necessary criterion for its success*."
>
> (Chapman, 2002, p. 177) (my emphasis)

Such 're-forming' has proven elusive. In their comprehensive review of the role of beliefs in mathematics education, Leder, Pehkonen and Törner (2002) point out that there is no 'consistent pattern' yet established as to why some teachers change what they believe and others do not, while Wilson & Cooney (2002) describe at length the complex, poorly understood, relationship between beliefs and practice.

Beliefs manifesting in teacher interpretation of curriculum

Understanding the role of beliefs in teachers' work entails appreciating that beliefs operate at multiple levels and cannot be ignored or circumnavigated (Nespor, 1987). Teachers are

the mechanism through which all intended curriculum is translated and interpreted into everyday activities and learning opportunities for students (Kupari, 2003; Nathan & Knuth, 2003). This interpretation is inevitably influenced by what teachers think is important (values), their view of their subject (i.e. their philosophy of mathematics) and how best to teach it, as well as their conceptions of their students. Other countries' attempts to circumnavigate this process of interpretation—i.e. to 'teacher proof' curricula—have failed (Lloyd, 2002). This filter on the curriculum exacted by teachers' beliefs can be powerful enough to recast new curricular materials into old practices (Furginhetti and Pehkonen, 2002), or take-up the *form* of the new curricula ideas without the *substance* (Brodie, Lelliott, and Davis, 2002).

Explicating beliefs empowers the teacher

Some suggestions of progress are offered in studies that describe teacher development programmes oriented around the explication of teachers' beliefs and their subsequent reflection upon these as a source of praxis (e.g. Freeman, 1991; Nathan and Knuth, 2003; Peacock, 2001; Walker et. al., 2012), although there is much less evidence of producing *change* in practice and thinking than there are studies describing it.

It stands to reason that just as no teacher can force a student to learn (Green, 1971), no teacher-trainer can force a teacher to change his or her beliefs. Such change, then, must be brought about by equipping teachers with the tools required for explicating and reflecting upon their own beliefs, along with fostering a motivational and safe environment that is conducive to doing so (Bruner, 1985; Rogan, 2007).

Understanding beliefs as a means of improving teacher practice in South Africa

Unfortunately attempts to 'apprentice teachers into reflective discourses' in the South African context have encountered significant challenges (Reed, Davis and Nyabanyaba, 2002), where limited subject and pedagogical content knowledge seemed to inhibit reflective ability. Most of the literature on studying teachers' beliefs originates from developed countries and the socio-economic 'North', and while the mechanisms used for

these studies may transfer, the contexts and challenges faced by teachers in developed countries differ drastically from those faced by South African teachers (Adler, 2002).

This does not mean, however, that beliefs should not be explored as a productive approach to teacher development in the South African context, even though some have questioned whether changing teacher dispositions (i.e. beliefs) falls within the remit of teacher development programmes (Brodie, Lelliott and Davis, 2002). I argue that if such beliefs prevent these programmes from achieving their intended outcomes, then beliefs *must* fall under this remit, for no progress will be made while they are ignored.

Overview of other research into teacher beliefs

Teacher beliefs in mathematics education

Most of the research about mathematics teacher beliefs and practices revolves around the constructivist mathematics education reform movement of the 1990s (e.g. Beswick, 2007; Gates, 2006; Lloyd, 2002; Yow, 2012). Despite research strongly in favour of the constructivist philosophy of mathematics teaching, most teachers do not subscribe to it (Cooney, Shealy, and Arvold, 1998) ostensibly because it differs so dramatically from their own experience of learning mathematics (Lloyd, 2002).

Across constructivist and cognitivist research alike, Ernest's work on varying philosophies of mathematics are still highly cited (Ernest, 2011; 1991; 1989) wherein he constructs three alternate philosophies of mathematics as a body of knowledge: mathematics as disconnected rules and formulae to memorize (the instrumentalist view); mathematics as conceptual, but concrete and 'universally objective' (what he refers to as a Platonic philosophy of mathematics); and mathematics as a socially constructed, dynamic human practice which is constantly being refined and enhanced (the reformist or constructivist perspective).

The valorisation of some of these philosophies over others is not necessarily desirable. Many accomplished mathematicians utilize algorithms (Skemp, 1976) and not all education systems that are generally considered 'successful' subscribe wholly to the constructivist school of thought (for an example see Kupari, 2003). However, Ernest's classification has proven fruitful in describing teachers' personal mathematical epistemologies and their teaching practice relative to their personal ideas of what mathematics *is*.

A comprehensive description of the vast field of mathematics teachers' beliefs is beyond the scope of this thesis. For further meta-analyses of the field, see Philipp (2007), Leder, Pehkonen, & Törner (2002), McLeod (1992) and Thompson (1992).

Teacher beliefs regarding language

Two particular studies present interesting research to consider in the context of this study regarding the use of language in content-subject lessons (i.e. not language lessons). Tan's (2011) study of Malaysian mathematics and science teachers across rural and urban schools is probably the closest to the South African situation in which this study is based. She found that content teachers did not really believe in their roles as language teachers for their English Language Learner (ELL) students, limiting their thought about language development to a narrow focus on their subject's terminology.

Pettit (2011) investigated teachers' perceptions of ELLs in their classrooms, and how willing they were to adapt what they did for students acquiring the LoLT. Her findings indicated that while teachers would espouse beliefs that were accepting of ELL students, their practice did not always reflect this. More concerning is that factors such as years of teaching experience, being multilingual, and having travelled to foreign non-English speaking countries amongst others—which might have been expected to positively influence teachers' attitudes towards ELLs in their classroom—appeared to have no significant effect.

Adler (2001) has described at length the multilingual mathematics classrooms in the South African context. She characterises the role of the content teacher teaching language as a 'dilemma': a trade-off between ensuring understanding and potentially losing time for content coverage in class.

Dilemmas offer fruitful opportunities for the study of beliefs: genuine uncertainty about the 'correct' course of action throws open alternative courses of action in a classroom, and teachers' choices of the 'correct' thing to do arguably exposes their personal beliefs about teaching far better than any questionnaire[13].

It is to this next issue, the measurement of an object of analysis as intangible as a belief, that we now turn.

[13] The *researcher's* dilemma regarding evaluative judgments of beliefs will be dealt with in Chapter 3.

Measuring beliefs

Pajares (1992) has pointed out that we cannot measure beliefs directly—we can only use what people say and do. This presents formidable validity challenges to the research of beliefs. Philipp (2007) gives a succinct overview of the strategies used by researchers of teacher beliefs before and after Thompson's 1992 review. He concludes that not much progress had been made in the quantification of beliefs to enable larger-scale studies, with most studies on beliefs being qualitative, detailed descriptions of small numbers of subjects. (This study is an example of the latter). He lists the primary means of measuring teacher beliefs as "combinations of classroom observations, interviews, surveys, stimulated-recall interviews, concept mapping, responses to vignettes or videotapes and linguistic analyses" (Philipp, 2007, p. 268). He advocates such rich collections of detailed data as they allow the researcher to "consider interrelationships in the complex world of teachers" (ibid. p. 268). This echoes Calderhead's (1996, p. 712) sentiments, that "by dwelling on one individual teacher, ethnographic studies are able to amass extensive data about a teacher's practice and to offer more detailed accounts of the relationship between thought and action".

This study is conducted in the same manner as those that Philipp describes. The group under consideration only consists of two teachers, and detailed, insightful descriptions of their worlds and worldviews are constructed using pre-interviews, observations, vignettes, linguistic analyses and more (see "Chapter 3: Methodology" for more specific details). This approach is inspired by Philipp's claim that rich datasets will yield the insights necessary to understand the link between teachers' beliefs and their practices.

Inconsistency in beliefs

Given the property of belief systems that allows clustering (Green 1971), inconsistent beliefs can be simultaneously maintained in the mind of the same person at the same time. Two beliefs that might seem contradictory, for example, could be:

1. the belief that mathematics and languages are similar types of knowledge
2. the belief that people are either 'maths' people or 'language' people.

It is when beliefs such as these 'bump up' against each other that further questioning and discussion is required. The researcher must ask: are inconsistencies between teachers' separate beliefs, or between their beliefs and practice, necessarily a problem? What is the aim of a researcher in approaching these inconsistencies?

Philipp (2007) describes how many researchers claim that such inconsistencies 'disappeared' once the thinking of the teachers they were studying was better understood. He proposes assuming that the inconsistencies are in the mind of the researcher, not the teacher. This leads to more inquiry, and results in a better understanding of teachers' beliefs and thinking. This is not to say that inconsistencies in teacher beliefs do not exist, but rather that the onus is on the researcher to establish their presence. Given that the study of beliefs also faces serious challenges of validity and measurability, claiming the existence of an inconsistency must be tempered by recognition of these difficulties.

Inconsistencies provide particular foci of interest for the researcher wanting to understand the implications of beliefs for teaching practice. Nespor's two alternate approaches to addressing beliefs in teaching dictate that, unless one is attempting to 'teacher proof' an education system, the sites of inconsistencies in beliefs and practice must become sites of praxis for reflective teachers. It is in this manner that inconsistencies will generate the cognitive conflict and subsequent discussion that will deepen teachers' practice in the classroom. Seen in this light, the uncovering of genuine inconsistencies is desirable.

Conclusion

This chapter has attempted to distil from a significant amount of research key ideas that are pertinent to this study. The result is a working definition of beliefs as values, propositions, affect and feelings, defined against a background of how beliefs operate within the field of teacher development and practice, as well as two potential frameworks regarding mathematics (Ernest) and language with mathematics (Adler) to use to describe teachers' beliefs. The next chapter outlines the methodology and execution of this study.

Chapter 3: Methodology

Having set the scene—geographically and academically—for this dissertation, the following chapter outlines the methods and data gathering instruments used. A description of the data gathering techniques, and how the data was processed and coded to provide a framework for the analysis, is provided first. This is followed by a justification of the suitability of discourse analysis as an analytical framework for the interpretation of beliefs that follows in Chapter 5. Finally, a discussion of validity and reliability issues generic to qualitative research, as well as specific to the analysis of beliefs in this study, provides the backdrop to the necessarily interpretative and subjective nature of the study's findings.

The design of this study

Studies of beliefs in the literature use both quantitative and qualitative methods. Most quantitative studies examined relied on the design of Likert scale-type instruments (e.g. Beswick, 2007; Hardré & Sullivan, 2008; Kupari, 2003; Pettit, 2011), which were issued to large samples of teachers. Some follow up an initial survey of this nature with interviews (i.e. mixed methods, e.g. Nishino (2012)). This study, being qualitative, employed the traditional qualitative techniques of interviews and observations (Golafshani, 2003), a common approach in studying teachers' beliefs (e.g. Aguirre & Speer, 2000; Beswick, 2007; Calderhead, 1996; Pajares, 1992; Thompson, 1992).

The view I take in this study is one of beliefs as constructed by, and constructive of, experiences, firmly placing the analysis in a constructivist position. This necessitates a small, detailed qualitative study, as outlined in the previous chapter.

This study does not claim to be an ethnography in the true anthropological sense. Rather, it took an ethnographic *approach*, in assuming that the cultural, economic and socio-political environment of the school and its teachers permeate the activities performed there, and are relevant to understanding the practices of actors within that space. Small events that did not fall into the official observations or interviews, or even under the traditional ambit

of 'typical school activity', were still considered salient and recorded (see 'Secondary Data' below).

The logistics of data gathering

Data collection in the field took place for a period of five weeks after the Easter holidays and before the mid-year exams in 2012. Rather than simply observing a few lessons and conducting interviews over a week or two, a longer period allowed for better immersion into the school and the development of relationships with the teachers. Biko Secondary provided a unique opportunity as I was familiar with the village of Makhaya and had pre-established contacts there. In addition, the principal was unusually open to researchers, allowing access that would otherwise be difficult to obtain[14].

While there were three teachers teaching mathematics at Biko Secondary, the third—who taught grade 8—was not a trained mathematics teacher. She had been allocated a mathematics class to fill her timetable because her own speciality subject, accounting, had been dropped by the school. While I initially gathered data for this teacher, it became apparent that her concern about participating and her anxiety around her own mathematics ability (as evidenced by her classroom observations) precluded any fair analysis of her mathematics beliefs and pedagogy, and she has been excluded from the analysis. This left the two specialist mathematics teachers, Thandiswa and Zolani, both of whom agreed to participate under the conditions outlined below.

Ethics

Teachers in South Africa, especially those in ex-DET schools, are known to be reticent about being observed due to the historical use of inspectors by the apartheid-era Department of Education (Chisholm, 1999). It was unsurprising that both Thandiswa and Zolani were concerned about direct footage of their teaching being made freely available to others, and their consent was obtained under assurances that this would not happen. The raw data for

[14] For example, repeated attempts to contact the Eastern Cape Department of Education (ECDoE) for permission to conduct the study resulted in only one conversation, with a concerned official worrying that I represented the press—the ECDoE at the time was experiencing massive challenges in leadership and confrontation with teacher unions (Gernetzky, 2012).

this study is, therefore, not available to other researchers, and pseudonyms have been created to obscure the identity of the school and the participants. The process of the study, along with said assurances, was explained in both English and Xhosa via ethics declaration forms (see Addendum H), which participants had the opportunity to take home and review.

Instruments used in this study

Data gathered during the study was classified as either primary or secondary data. Primary data was gathered using instruments and observations explicitly intended to gather information about the beliefs of the teachers participating. Secondary data included information that was not directly aimed at beliefs, but did identify many important contextual factors that would have significant impact on the teachers at Biko Secondary and how they viewed their world. In addition, secondary data enabled my own reflexivity as a participant-observer, gathering information about my experiences and how they coloured the study.

Primary data

The primary data included a pre-interview for each teacher, followed by classroom observations and then a stimulated recall post-interview (Aguirre and Speer, 2000; Thompson, 1992). Each was intended to gather information about the participating teachers' beliefs, either espoused or enacted.

The pre-interview

The aim of the pre-interview was to gather historical data on the teacher about their own schooling experiences both as students and as trainee teachers. In particular, their linguistic identity was explored using Busch's (2010) graphic linguistic profile, a technique that also facilitated discussion around their beliefs about language (see Addendum B).

Further questions in this interview followed a semi-structured approach, with discussion veering away from the initial list of questions as points of interest arose. The original questions were designed using the Venn diagram below: this was developed specifically for

the current study, in line with Green's (1971) formulation of beliefs as systems, and has been found consistently useful in structuring these teachers' belief portraits.

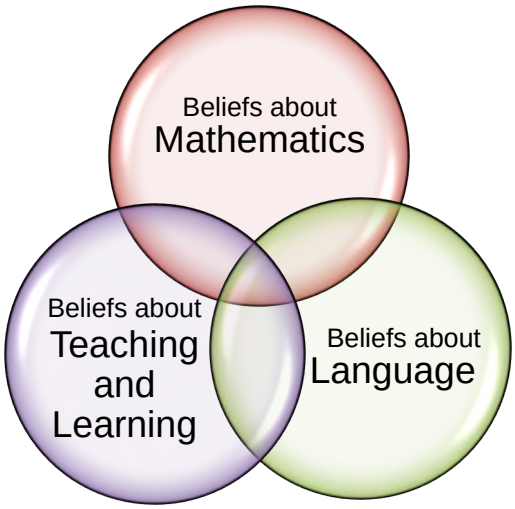


Figure 1: The initial Beliefs Area Map indicating the themes under scrutiny and their potential overlap.

Interview questions explored teacher beliefs about the three primary areas of the above map i.e. mathematics, teaching and learning in general, and language, as well as their intersections: the teaching and learning of mathematics; the teaching and learning of language; the interaction of mathematics and language; and, at the epicentre, the relationship between mathematics, teaching and learning, and language. Questions around mathematics, and mathematics teaching and learning, were framed by Ernest's (1991, 1989) model of mathematics beliefs. Inquiry into these areas was initiated using a mathematics problem selected by the researcher from a textbook the teacher used in her class (for further details about the instrument used, see Addendum A). Questions about the interaction of mathematics and language were informed by Adler's (2001) framework of dilemmas, and questions relating to the interaction of all three areas were informed by Barwell (2009), Pimm (1987), and Setati and Adler (2000).

Observations

For each teacher, four hour-long observations were scheduled, each of which was recorded using a video camera (see "Validity and Reliability" later in this chapter for the difficulties this created and how these were partially mitigated). In the case of Thandiswa, one

observation was missed due to a miscommunication about the school schedule (see "Secondary Data" later in this chapter).

Each observation was then watched twice while still in the field, and utterances and events that could be considered evidence of beliefs were compiled into a list of discussion topics for each teacher. Each point of discussion was also classified based on the Beliefs Area Map shown in Figure 1. However, at this point it became apparent from both the initial interviews and the observations that the Beliefs Map was missing a critical component, which is reflected on the revised Map below:

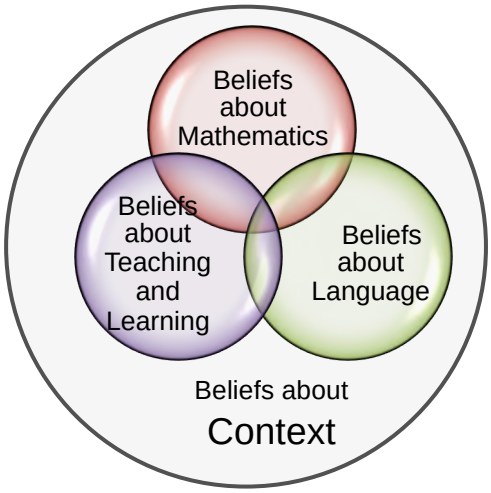


Figure 2: The revised Beliefs Area Map, showing the embedding of specific beliefs in context.

This additional category on the Map was added after watching the observational footage and included in the post-interview discussion topics.

The Likert Scale

Once both teachers' lessons had been analysed for evidence of beliefs, certain commonalities between them became apparent. These were distilled to ten statements spanning various areas of the Beliefs Map and were phrased as propositional sentences with no clear 'right' or 'wrong'. These were then used to produce a new instrument in the field in the form of a Likert Scale (see Addendum F), which was completed by each teacher as part of their stimulated-recall interview. There was no 'neutral' response on the scale, with four potential response options: "Strongly Disagree / Disagree / Agree / Strongly Agree". This

was done in order to have some areas of belief that were directly comparable between the teachers, and also to confirm suspected beliefs that had been identified from the original interview and observations[15].

The stimulated-recall (post-) interview

Once the initial interview and observations had been combed for evidence of beliefs and compiled into a list of topics for discussion, each teacher then participated in a stimulated recall interview. This involved the researcher and teacher going through the topics together on a shared screen, discussing each and referring back to the classroom videos where required (see Addenda D and E). Through these discussions, teachers could provide further explication or justification for certain choices. Like the pre-interviews, the stimulated recall interviews were also voice recorded.

Secondary data

In addition to the primary data gathered, the following secondary data were also obtained to ensure as complete a description as possible of Biko Secondary's teachers and their world.

Student demographic survey

A basic questionnaire was designed and translated into Xhosa for Thandiswa and Zolani's students, to obtain more information about their socio-economic background, their mathematics achievement at school and their linguistic repertoires (see Addendum C). These were issued to all the classes observed. The responses provided useful confirmation as to how typical a school Biko Secondary—and the broader community of Makhaya—are, given their geographical location (see Chapter 1 for some of the insights these questionnaires yielded). All student questionnaires were voluntary and anonymous.

[15] This seemed especially prudent given that there would not be a second chance to return to the field and gather further data.

Unrecorded observation of English lessons

While in the field, it became apparent that further insight was required into what opportunities the students had for developing English as their second language and medium of learning. To this end, I observed a Grade 9 English lesson to establish the type of discourses in the school around English acquisition. This observation was not video recorded due to ethics constraints with this teacher, who had not initially agreed to participate in the recorded lessons.

Interviewing the principal of Biko Secondary

To gain insight into the overall running of Biko Secondary, the principal was interviewed to obtain his perceptions of the academic and logistical challenges in the school. This also shed light on the relationship between the community of Makhaya and the school. The interview was audio recorded and transcribed, and used for reference while analysing the teachers' beliefs about their work.

Revised versions of the observation and interview schedule

The scheduling of activities at Biko Secondary proved far more fluid than I had expected given my own experience of schooling. While in the field, it seemed prudent to keep a history of these changes in the school timetable; a source of data that revealed the loss of lesson time and the reasons for it. This exposed beliefs about schooling and its structure that were both surprising and revealing.

Reflective researcher's journal

Finally, perhaps the most extensive secondary data took the form of a 30 000 word reflective journal that detailed my own experiences within Makhaya as a visiting researcher living among the permanent residents. This proved a rich source of data on the everyday, lived experience of the village and my own subjectivity therein.

In a paper entitled "Research methodology for rural education in South Africa" (Gardiner, 2007), the Centre for Education Policy Development described challenges in conducting field research in schools similar to Biko Secondary, which mirror my own. In particular, they

highlight the heightened reflexivity on the part of researchers that such studies generate, along with the need to be adaptive, since "in this kind of research, we should expect not only the unexpected, but also full complexities, contradictions and conflict if the research addresses meaningful matters" (Gardiner, 2007, p. 3). This was indeed the case for my own study: the secondary data instruments described above were necessary not only for richer data, but also as a form of catharsis to deal with the shifting conditions that threatened the study. By doing this, each change could be considered important for a truthful and accurate description of the context in which the teachers at Biko work, rather than as a barrier to the study's successful completion.

The analysis process

Once all the data, both primary and secondary, had been gathered as described above, it was necessary to transcribe the interviews and observations for analysis of the text. Gee et. al. (1992) caution against the assumption that transcription of oral texts into written ones is neutral, but all efforts have been made to encode oral utterances accurately so as to depict their relevance to beliefs. (See 'Positionality' below for further problematization of the author's subjectivity).

Once the initial and final interviews were transcribed, they were analysed for utterances or sequences of utterances that could be construed as beliefs as defined for this study. These were all framed as "belief statements" that could be prefixed with, "This teacher believes that…". They were then coded with a unique identifier and a numeric code indicating which area of the Beliefs Area Map that belief fell into (see Addenda I and J).

To further foreground any subjective bias in the questioning process during interviews, beliefs extracted from the text were given a validity indicator from most to least reliable, according to the following scale:

- implicit (beliefs implied without being stated directly)
- explicit (beliefs stated directly, without being asked for)
- prompted (beliefs asked for and responded to convincingly)
- led (beliefs attributed through leading questions and single word responses).

The classification of utterances by the teachers was done conservatively: that is, if in doubt as to which category would be more appropriate, the default category would be towards the less reliable end of the scale described above. Beliefs that manifested implicitly, without the interlocutor stating their thoughts directly, were considered more reflective of that teacher's genuine beliefs than a belief that was only arrived at after leading questions from the interviewer. Thus problems of reliability due to leading questions from the researcher were partially mitigated. All beliefs gathered via the Likert scale were considered 'prompted'.

Discourse analysis as a mechanism of exploring beliefs

The choice of discourse analysis to explore the beliefs of Thandiswa and Zolani is premised on beliefs as socially constructed understanding, inseparable from the discursive environments in which they are formed and enacted.

The study of beliefs, or any form of meaning-making, within a positivist paradigm is severely limiting (Edwards, 1997; Lerman, 1994). If beliefs are an individual's tacit and overt knowledge, feelings, attitudes and values, then the constructivist approach to knowledge must also apply to beliefs. Meaning-making, learning, and knowing, are not mere psychological transitions from "pre-knowing" to "post-knowing", but rather socially-situated in the midst of language and its discursive power, and the frames of reference that constitute 'meaning' to that person in that space (Lerman, 1994). The definitions of beliefs explored earlier have indicated the philosophical difficulty of divorcing knowledge from its holders and their subjectivities, undermining the argument for an objective 'truth'. Therefore, the best we can do is to name that on which we can find consensus as 'knowledge'.

This notion of the dynamic, situated construction of knowledge thus admits the assertion that beliefs are malleable and can change over time, with exposure to new experience and evidence (Green, 1971; Thompson, 1992), as well as manifesting differently in one situation to the next depending on the discourses at work. This issue of *manifestation* is particularly important when studying beliefs: as an object of analysis, the belief (or belief system) itself

is not directly observable, and hence must be inferred (Pajares, 1992). These difficulties relating to validity and reliability are explored later in this chapter.

This study takes the constructivist position, then, in that multiple realities held by different actors are valued and no single person is assumed to have access to an objective 'truth'. Rather, it seeks to lay multiple subjective truths side by side (including the author's) and explore and unpack them so as to generate understanding around *why* the holders of these truths have come to believe them.

Given, then, that beliefs are socially constructed and context-embedded, analysing them requires a theory that takes the complexity of social activity into account. Cazden (*Classroom Discourse* Analysis, 1988, pg2) noted that "speech unites the cognitive and the social". Given that we have already mentioned how beliefs also span the cognitive and the social, the analysis of speech then offers a potential mechanism for inferring the beliefs of the speaker. Consider Halliday's tripartite categorisation of the functions of speech as described in Cazden (1988):

- "the communication of *propositional information* (also termed referential, cognitive or ideational function)
- the establishment and maintenance of social relationships
- the expression of the speaker's identity and *attitudes*." (pg 3) (my emphasis)

We have defined beliefs in this study as inclusive of propositional knowledge, values, attitudes and affect. It is not difficult to see how these three speech functions map on these various framings of beliefs, although this mapping is not one to one.

The analysis of speech alone, however, will not suffice to examine the construction of knowledge as a social practice. It is the analysis of *discourse* at work in social activities (Gee, Michaels, & O'Connor, 1992) that will reveal what the actors believe about the world and how their co-actors and contexts construct those beliefs. Gee et. al. define a 'social activity' as follows:

> "A social activity involves conventional expectations about the roles participants will play and the characteristic ways in which people playing these roles are expected to act, interact, and appear to *believe, value and think*" (Gee, Michaels, & O'Connor, 1992, p. 234) (my emphasis).

From this extract, it becomes clear how beliefs manifest socially, informing action and being informed by action. Discourse analysis is appropriate to the analysis of beliefs within social activity as:

> "(I)t is the business of discourse to formulate and deal with the nature of the world outside and the world within: with reality *and* mind, and the relations between them" (Edwards 1997, p. 19, my emphasis).

Discourse analysis, then, offers what superficial examination of speech cannot: a means of connecting action and uttered thought to the power structures that shape and define how social activities and their participants are embedded within a socio-cultural setting. It reveals how their experiences constitute their beliefs in that setting.

However, beliefs—in particular their abstract nature—throw up many methodological challenges which must be addressed in order for this study to be credible. Speer warns researchers of teacher beliefs to beware attributing beliefs as 'espoused' by a research participant:

> "I contend that it is inappropriate to classify any data on beliefs as purely professed. All claims about teachers' beliefs are, to greater or lesser extents, attributed to teachers by researchers." (Speer, 2005, p. 362)

The researcher, then, is a participant in the discursive practices of the interviews and observations used to gather information about beliefs. She may, if not wary, be complicit in helping to construct them in a different manner to how the participant might construct them without her presence. The next section discusses this issue of the researcher as invisible participant, and the validity and reliability concerns in studying an abstract object of analysis.

Positioning

The earlier mentions of knowledge as subjective and constructed, along with belief statements as researcher-attributed, indicate that an unavoidable part of this particular piece of research was that of my own positionality as researcher. Foote and Bartell (2011) locate the term 'positionality' in feminist theory: a movement of academic thinking towards appreciating bias and limitations in all viewpoints and interpretations, and particularly concerned with exposing those whose voice claims universal legitimacy over others who are voiceless.

Examining positionality is particularly important as a researcher looking to describe and understand beliefs. Thompson made clear…

> "…the importance for researchers studying mathematics teachers' beliefs to make explicit to themselves and to others the perspectives they hold about teaching, learning and the nature of mathematics, because these perspectives greatly affect researchers' approaches to and interpretations of their work." (Thompson, 1992, p. 258).

Examining my own positionality goes beyond merely reflecting on my own beliefs about mathematics, language, teachers and learning. The importance of couching specific beliefs in the social context of the belief holder has already been discussed, and this must also extend to the reflective researcher. If this study is to employ discourse analysis, then all discursive acts at the social level should be critically examined, including my own.

Staeheli and Lawson (1995, p. 332), quoted in Rose (1997, p. 307), discuss the particular issue for feminist scholars from developed environments who conduct field research in developing spaces:

> "(W)hen Western feminists enter developing settings, they cannot escape the power relations that exist between those societies or between themselves as academics and their research subjects, even when they wish to do so. Western researchers are in a position of power by virtue of their

> ability to name the categories, control information about the research agenda, define interventions and come and go as research scientists."

Foote and Bartell (2011, p. 46) echo the same warning:

> "Our perspectives as researchers, the methodologies we choose, and the questions we ask are informed by what we consider salient aspects of our prior knowledge and experience."

For my own position, Staeheli and Lawson's observation is inescapable: despite being of the same political nation as my research subjects, that is as far as the commonality goes. We are from very different sides of the spectrum of social power. Given the context of the South African racial divide, as a middle class, white researcher, I am very much "Western" in comparison to the rural space in which I conducted my research; a holder of all the privileges that being middle class, Anglophone and white bring to the vast inequality within South Africa.

Like Rose (1997), I assume my own thoughts and knowledge as a heterosexual, white Anglophone, young, middle class woman to be partial and situated. I also assume my research participants' knowledge to be partial, as all knowledge necessarily must be. There is no 'master position' from which to survey and assess all other positions (Christie, 2008).

But I must also 'open the gaps' in my research, as Rose suggests, by exposing my own sentiments and beliefs: not only about mathematics, language and teaching, but at a more fundamental level regarding what knowledge it is that I privilege, and what values I hold.

One of my own beliefs that I cannot reconcile with my wish to avoid a deficit narrative of my research participants, is that somehow the knowledge I have been privileged to acquire is more desirable than theirs. This is not due to my race, class, gender or age, but rather due to my increased *access* to education and opportunities as a result of these demographic factors. To deny this sense of desirability would be dishonest, omitting that filter through which my interpretation has inevitably passed. It would also be to deny my belief in education as a progressive force for human development. That much of my own education has been highly discursive cannot be denied… and yet, in spite of this, my own life narrative

has led me to a point where it is possible to simultaneously appreciate my own acquired knowledge, and realise that it is limited, positioned and up for questioning. This is something I value highly as a researcher and educator—a core belief of my own—with which I am unable or unwilling to part.

This is not to say that the knowledge that my participants have to which I am not privy is undesirable, nor that their ways of knowing are necessarily 'wrong'; rather that, uncomfortable as I am with my own position, it is there and I am unable to resolve it, or reason it away. Rose chose the words 'anxieties' and 'ambiguities' to describe the challenges in reflecting upon one's position as a researcher, and both resonate deeply with my own fieldwork experience.

Through the reflective aid of a journal throughout my fieldwork, the everyday events of interacting within the school and broader village space acted as the proverbial pea under the mattress, to remind me of these unresolvable differences of position between myself and the people around me. Rose quite rightly points out that while reflexivity is laudable, desirable and necessary for critical, oppositional forms of scholarship, it is extremely difficult—if not impossible—to do in a manner that is fully transparent. Nor is it without problems of its own, for claiming transparency in reflexivity is as necessarily bound to fail as claiming universality of knowledge. It is only in offering positioned, transparently biased and honest knowledge production that a researcher can make lay any claim to truth in her assertions (Rose, 1997). As Christie (2008) argues, it is by laying side-by-side different perspectives and interpretations that genuinely rigorous research can take place.

Drawing on hooks (1984) on being simultaneous "outside" and "inside" resonates for this study: as a white, middle class graduate student, I am 'inside' the corridors of power—what hooks' refers to as a 'central' position—with access to material as well as social resources and most crucially, that single looming distinction between my research subjects and myself: my ability to opt-out and leave any time I chose to. It is my voice, my decisions and my ability to see, or not see, that shapes this report.

Simultaneously, I was on the "outside" in their world, in their space and ways of being. This came out frequently in everyday interactions, with my research participants and the

broader village community. My position as a relatively 'young' woman was not a position of power in the space of a patriarchal, rural village. Being 'othered' by men in the village gave me a deep sense of vulnerability, a difficult mind-set to work from when attempting to conduct open and honest research. My experiences of being followed by a particular young man, and needing to draw on the support of the village elders and hierarchical structures for intervention, exacerbated this sense of vulnerability. It also gave me a sense of what other young women in this space experience frequently, and again the emotions were ambivalent: frustration and fear for being on the receiving end of persistent, unwanted attention, combined with gratitude for my ability to opt-out should I so choose and to claim 'special status' as an outsider which could assist me in finding shelter from this attention. However, rather than establishing a shared 'female' experience, my own reservations about the gender dynamic in the village were described by some teachers at Biko Secondary as 'weak' and 'child-like'. I did not manage to fathom what fuelled their dismissal of my expression of vulnerability in response to what I perceived as threatening behaviour.

The difficult dynamic of being an outsider also presented as 'intruding'—particularly within the school space—placing me as a researcher on the outside in a very different way. Teachers are notoriously averse to being observed, and as already noted, teachers in the South African context are particularly and understandably mistrustful (Chisholm, 1999).

The dynamic of 'intrusion' was not, in my opinion, met passively. Some of the actions of the research participants could be interpreted as disruptive, although one should be mindful of equating disruption with malice. Rather, small acts of disruption of my research on their part can be seen as acts they felt necessary for survival, perhaps even as small, subconscious efforts to claw back a sense of power that they felt they lacked in their interaction with a privileged white researcher, whose presence had been mandated by the principal, and whose invitation they had no hand in extending.

Minor acts of disruption that made this research challenging concerned the teachers availing themselves. Times for observations would be arranged and then changed at the last minute. Throughout the month of data collection, approximately six different versions of the observation and interview schedule were drafted. Interruptions included forgotten

union meetings (although these meetings were weekly and regular) and forgotten sports outings to other schools (which consumed entire school days). One teacher claimed to forget that the school closes early on a Friday: a fact not represented on the official school timetable, but one that was routine according to the students. Observations of the first lesson of the day were often abandoned due to teachers' late arrival, which was complicated as teachers shared transport. The net result of the meetings, sports events and early closures was up to 50% of school lessons being lost over the research period. This was obviously not only disruptive to research, but to learning and teaching across the school. The act of disruption to research specifically, however, was through many apparently regular events being declared only once I had arrived for an observation. My research participants may have been concerned about how I might view the loss of lessons on such a regular basis, and hence were hesitant to declare known changes to the school timetable, preferring to claim they were 'forgotten' or exceptional.

It is extremely difficult not to judge these events collectively as a 'way-of-being' in the school that was disruptive to students' learning. Even in the presence of a rationale for each of these disruptions, their collective effect jarred strongly with my own personal values not only as a researcher, but also as a teacher for whom lesson time is sacrosanct.

The only way I have been able to reconcile these ways-of-being with my own beliefs has been to cast these too as enacted beliefs, collectively, on the part of the teachers: beliefs with which I personally disagree, but must seek out their basis by examining the context and pressures under which they have developed.

Once this tension between researcher and researched is revealed for what it is—when the researcher declares what positions she knows (and assumes there are positions she doesn't)—even then, the nature of the knowledge she produces is still subject to the interpretative eye of the reader (Rose, 1997). The power of any such research, cast as it is by the will of the researcher, can yet be exposed or reified by the position of the reader. As a developing researcher, I can only do my utmost to reflect upon my own position and the problematic, pluralistic power dynamics between myself and my research participants. It is

then for the reader, as cautioned by Rose (1997) and others, to keep in mind the positionality of my voice when reading any interpretation of this study's findings.

Challenges of validity and reliability

I have built an argument for the connection between speech and belief that has thus far ignored one rather important issue: that one does not always say what one believes, or believe what one says. What now follows is a discussion of how the findings in this study can be seen as truly representative of what they purport to show.

Reliability and validity are problematic concepts in a qualitative study of this kind, as neither transfers well from their origins in positivist, quantitative research. Rather, the qualitative researcher should seek credibility, precision and transferability in their stead (Golafshani, 2003). The remainder of this chapter describes aspects in the design and implementation of this study that were intended to mitigate the very real risk that the findings are not truly representative of what my participants think and believe.

Triangulation

The first aspect of this study's design intended to increase the credibility of its findings was the triangulation of the primary data between an initial interview, observations and the stimulated-recall post-interviews. By analysing for the same object—namely what that teacher thinks and feels—through multiple data sources, the probability of obtaining an accurate impression is increased. Where all three forms of data correspond, this can be seen as confirming of those beliefs. Where they do not, it is my role as researcher to ascertain why this might be the case, and not to immediately dismiss the teacher as contradicting herself. Rather, there may be underlying sense in her world as to why she enacts differently in the classroom compared to an interview for example, and contradictions across data forms expose the need to delve deeper (Philipp, 2007). My presence as an observer must be included in such underlying motivation, and this should be considered in a genuine discourse analysis.

Teachers' access to questions and notes

The use of a shared bank of questions visible to both myself and the teachers when conducting the post-interview was intended to provide teachers with the opportunity to resolve any misunderstandings on my part about their classroom practice or prior statements. By the time post-interviews were conducted, it seemed to me that both participants felt more at ease with correcting or clarifying than perhaps they did at the beginning of the research. This, combined with my refusal to show any data to anyone else other than the participant in question, was the best way I could think of constructing the 'safe space' mentioned by Bruner (1985) in which my participants could talk and reflect on their interpretations of the world.

Not looking for the 'typical'

The impossibility of observing a classroom as an outsider without *changing* that classroom's dynamic has been the subject of much angst for education researchers. How does one bear witness to 'typical classroom activity' without changing the very activity we wish to study? *Especially* in situations like this study where the power dynamics and social 'awkwardness' between researcher and teacher are so apparent?

This presented a serious challenge to my research design—I needed to find some other way of getting at what my participants believed and thought about their work without telling them to 'go on as usual' as they simply could not. Rather than seeking to observe 'typical' teaching by my participants, I deliberately asked for *atypical* teaching, by asking my teachers for their *best* practice[16]. The first three observations were conducted to allow each participant to become accustomed to my presence in their classroom with the camera, and the final observation was their opportunity to demonstrate what *they* felt was the best way to teach. Through this, I could observe which forms of teaching practice and classroom interactions they valued above others, and in doing so infer their beliefs about these.

[16] Many thanks to Dr. Heather Jacklin for this ingenious idea.

Looking for external cues of 'normalcy'

The secondary data gathered in this study proved useful in that it drew my attention to other ebbs and flows in the rhythm of the school day. In this regard, I interpreted several key events as indicative that my presence had not drastically altered practice at the school. Some of these events include:

- teachers' use of students during lesson time for chores not related to learning (e.g. making tea for teachers, cleaning the library, fixing the teachers' hair)
- teachers seeming comfortable to leave their classrooms for extended periods during lessons, leaving students working without supervision
- teachers marking or setting exams during lessons
- the early closing of the school, or late starting of lessons due to external events, transport issues etc.

Given that these sorts of practices are the type that might draw ire from an inspector or department official, I understood their continuing in my presence as indicators of a certain degree of indifference—or at least that my presence was not construed as professionally threatening.

Clues to my positioning by the teachers and school community

Of course, my presence must have had some impact. One instance where this was demonstrated was Zolani's comment in her post-interview that she felt she could not discipline as forcefully in front of a guest as perhaps she normally would. I took this to mean she uses corporal punishment, which is reportedly common in schools like Biko Secondary, and it was useful and honest of her to admit as much.

Another useful insight into how Zolani saw my presence was her unprompted statement as I concluded her final interview: "I'm not sure kaloku (really) if that's what you expected of us", indicating concerns that I had brought preconceived ideas about what I would find at Biko Secondary. I also interpreted this as Zolani's way of signalling to me that she had shown me her best teaching, and that she was hoping I was pleasantly surprised by what I saw. Given my goal to unpack beliefs by asking for 'best practice', this was encouraging.

Finally, a comment from the headmaster, during the final tea I arranged to thank the staff at Biko Secondary before I departed, gave me insight into how the staff had positioned me as a 'child' and hence probably in a less threatening role than perhaps might have otherwise been the case. On donating a multilingual dictionary and atlas to the new school library, he stated, "Noxy! You have chosen exactly the books our library needs. You are not the child I thought you were." While this positioning came through in my journal as well (along with my frustration at it) it was arguably a blessing in disguise. It implied my presence was not seen as that of an 'authority' (which I was not), or 'fellow teacher' (which I was, and openly stated as much), but rather as a young graduate who was not familiar with the challenges of education in general and schools in particular: a 'child', who would not be a threatening presence to adults.

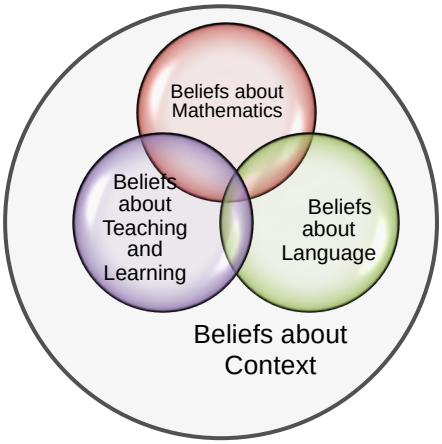
None of these attempts to mitigate the challenges to this research are guaranteed to be effective, and some of the events described begin to hint at the complex power domain of research practice. Through the acknowledgement of my own voice's subjectivity, and by retaining cognisance of this throughout the analysis process, I have attempted to minimise the impact of the subjective dynamics present in the study on the findings described. Beyond these reflections, it now falls to the reader to decide the credibility of this study's findings.

Chapter 4: The Teachers' Beliefs

Introduction

Having described how extensive data was gathered through many different media, I now turn to describing those findings. The main research question bears repeating: what do Thandiswa and Zolani *believe* about their work and their world? What do the findings of this study reveal about their perspectives?

The chapter analyses the teachers together, beginning with a narrative description of each teacher's history and educational background, followed by a synopsis of their beliefs according to the revised Beliefs Area Map shown in Figure 2 and repeated here for reference.



The codified belief statements

The process of closely analysing the texts from the initial and final interviews resulted in an abundance of information for both teachers: 99 distinct belief statements for Thandiswa and 140 for Zolani (see Addenda I and J respectively). Table 3 gives a sense of how many beliefs fell into each validity category for each teacher.

Teacher	Implicit	Explicit	Prompted	Led	Total
Thandiswa	10	33	47	9	99
Zolani	38	64	31	7	140

Table 3: the distribution of belief statements according to their trustworthiness, by teacher.

The discrepancy in number arose partly out of Zolani's longer teaching career, combined with her confidence in discussing her work, as evidenced by how many thoughts she offered unprompted compared to Thandiswa.

Some of the belief statements gleaned from these interviews may seem obvious to the reader. It is my contention here, however, that nothing should be assumed or taken as 'obvious' when attempting to understand another perspective. By documenting every potential belief, either directly espoused or indirectly inferred, possible connections *between* beliefs can also be identified. This generates a fuller description of the holder's belief *system* (Green, 1971), and potentially exposes a person's *reasoning* for their beliefs.

Personal histories

Thandiswa

Thandiswa was born in 1969 in a small town approximately 100km outside of Grahamstown in the Eastern Cape. She had been teaching at Biko Secondary School for 12 years, teaching Grade 9 mathematics, Grade 12 mathematics and maths literacy, and life sciences (biology). She now lives in Kwabantu with her adult son, her two sisters, and two infant nephews. She travelled to Biko Secondary daily using shared transport with the other teachers.

Language

Xhosa is Thandiswa's home language. She can read and write English, Xhosa and Zulu, the last of which she "just learned (it) around", implying she has friends or acquaintances who speak the language. She is confident in her speaking, reading and writing of Xhosa, but not with her English speaking, although she reported being "very confident" with English *writing*. She can also write and read Zulu, but not speak Zulu "fluently". Thandiswa has aspirations to learn other South African languages, predominantly based on aesthetic: she says she loves the sound of Venda, and the sound of Afrikaans, and although she does not see a use for either, she "really likes the way they're talking: it sounds so interesting" (see Thandiswa's visual language portrait in Addendum B).

Education

Thandiswa attended high school in her hometown, which fell into an apartheid era homeland. She was supposed to write her matric in 1986, but there was social upheaval at the time ("there were a lot of riots": Thandiswa Initial Interview), and hence she only wrote her school exit exams in 1987. She did well in her mathematics and science classes, and of all three teachers teaching mathematics at Biko Secondary, Thandiswa is the only one with a post-matric qualification that is not a teaching diploma or addition thereto: she obtained an N3 level diploma in electro-chemical engineering and was very proud of this achievement.

Thandiswa completed her three-year teaching diploma at Dr. W. B. Rubusane Teacher Training College[17] in King Williams Town in 2001. The teacher development programme included a lot of school-based experience, which Thandiswa felt was a good aspect of her training.

Thandiswa recalled that during her own mathematics lessons at school the teacher code-switched a lot, even though their LoLT was officially English, because school leaving assessments were written in English. She described her experience of writing exams in English as difficult, particularly in understanding the questions ("you don't know what is being asked"). This attribution of language barriers to predominantly *written assessment* was a common theme throughout her reflections.

Despite having studied mathematics as part of a post-school diploma and being relatively confident in her acquired mathematics abilities, Thandiswa still felt she needed extra training on some of the areas of the mathematics curriculum that she has to teach: to this end she had signed up for an upcoming mathematics teacher development course at Rhodes University in Grahamstown. During other activities in this study, she expressed some reservations about her own skills and abilities, giving an impression of low self esteem. In fact, small indicators of lack of self confidence periodically manifested throughout the study for both teachers.

[17] Dr. W. B. Rubusane Teacher Training College was one of the apartheid-era Bantu Education teacher colleges that was closed after the termination of apartheid in 1994.

Zolani

Zolani was born in 1970 in the Transkei, and moved to East London when she was six years old. At the time of this study, she was in her 18th year of teaching mathematics at Biko Secondary, teaching grade 10 and 11 pure mathematics, and grade 12 maths literacy. She also lives in Kwabantu and travels to and from Biko Secondary daily using shared transport with the other teachers.

Language

Zolani's first language is Xhosa, although she also speaks and writes English: she self-evaluates her communicative abilities in these two languages as proficient. She can also read and write Afrikaans well due to learning it at high school, although she does not feel as confident about Afrikaans as a spoken language.

Like Thandiswa, Zolani would like to learn other languages based on their sound: she expressed a desire to learn French and siSwati (the language of Swaziland) although her visual linguistic profile[18] indicates she feels this is unlikely as she "does not travel very much" (see her visual language portrait in Addendum B).

Education

Zolani completed high school at an ex-DET school in East London in 1990. Unlike Thandiswa, Zolani said that they did not lose class time at her school, stating that they were "very disciplined", implying that she and her classmates did not get involved in the political activity of the time. She described her own mathematics teacher in high school as a "very dedicated lady", whom she found inspirational and wished to emulate. She credits this teacher with inspiring her love for mathematics. Zolani achieved a D aggregate (50-59%) for mathematics on her school-leaving certificate, although she insists this did not reflect her affection for the subject.

[18] Zolani described herself as "not very creative" when asked to complete the visual linguistic profile: this is one of the instances where she seemed less confident in her own abilities.

After completing high school, Zolani went straight to teacher training college, attending the Griffith's Mxenge Teaching Training College in Zwelitsha in East London. She felt sad that the college had been closed and turned into a police station, as she values her training from that institution highly, and feels the current teacher training programmes (most notably the one-year Postgraduate Certificate in Education) provide inadequate preparation for teaching.

Once she had completed her teacher training in 1994, she felt a strong desire to work in a rural setting to provide access to mathematics for students in rural schools, and took position as a mathematics teacher at Biko Secondary in 1995. She has been there since.

Zolani is confident in her own mathematics ability ("I have a lot of subject content"-Zolani Initial Interview) and has attended many development workshops with the Department of Basic Education. She is now a cluster leader (a senior teacher who guides other mathematics teachers in schools in her area) and head of mathematics at Biko Secondary. It became apparent later in the study that her many years at Biko accorded her a significant position of respect amongst her peers: the other teachers seemed far more willing to listen to her, and follow her instructions, than they did the principal, who had only been at Biko for three years and was still negotiating challenging relationships with the staff.

Despite code-switching occurring throughout her own mathematics education at school, Zolani felt that she and her classmates had a solid grasp of English and that they had no troubles in understanding the material from lessons:

Sara: "ok, so you'd code-switch a lot in class?
Zolani: ja…but man, that time, we understood
Sara: mm!
Zolani: we understood, yo, for real
Sara: and the code switching didn't get in the way?
Zolani: mmhm (no), and we… we were not bad at English also."

(Zolani, Initial interview)

These recollections provide useful background when we later analyse Zolani's perspectives on the role of language in the mathematics classroom.

Zolani was a strong presence in the staffroom at Biko Secondary and her beliefs about the students seemed influential. We now turn to a closer description of what she and Thandiswa believed about their work as mathematics teachers.

Synopsis of beliefs

The narratives in the previous section provide an important background for understanding these teachers' thinking about their work and world. As we explore their existing beliefs, it is valuable to bear in mind their own schooling, and the body of evidence to which they have been exposed, when considering the sources of those beliefs (Green, 1971). I will use the Beliefs Area Map to explore these teachers' beliefs, going area by area to construct Thandiswa and Zolani's belief portraits.

Beliefs about mathematics

Most of Thandiswa and Zolani's beliefs about the nature of mathematics focused on procedures, algorithms and the memorization of mathematical conventions, what would be referred to as "instrumental understanding" (Skemp, 1976) or what Ernest (1989) refers to as an 'instrumentalist' view of mathematics: "an accumulation of facts, rules and skills". The following extract from Thandiswa's interview provides some substantiation to this claim. In this extract, she selects an equation from the textbook to illustrate her point about what counts as evidence of mathematical understanding:

Thandiswa:	"Ok, let's, let's look at this one. This is '4b is equal to 24' neh? I'll know, I'll know she does, she does understand maths if he[19] divides by four…
Sara:	Ah, ok!
Thandiswa:	Knowing the, the multiplicative of… uyabon'? *(you see?)*
Sara:	So she understands that the '4b' means 'four multiplied by b'?
Thandiswa:	Understanding the… BODMAS …which one to start.
Sara:	ok, ya
Thandiswa:	BODMAS I think that, that is the one."

(Thandiswa, Initial interview)

[19] This is not a transcription error: many first-language Xhosa speakers struggle with differentiating male and female in the third person singular in English, as Xhosa does not do this.

Rather than identifying the idea of equal value on either side of an equation and preserving the integrity of the notion of 'equals', Thandiswa immediately focuses on "which one to start" (i.e. 'the first step'). She then concludes her thoughts on the notion of the order of operations, a mathematical convention conveyed using the mnemonic 'BODMAS'[20].

Zolani's approach to this question was similar in her interview:

> "They must know this (pointing to '4b') is multiplying, uyabon'? *(you see?)* Multiplying, so the opposite of multiplying is? Divide! So they have to divide. If it was dividing, so they have to multiply. If it was added, they have to subtract it. Both sides! What you do this side, you have to do on the other side also."
>
> *(Zolani Initial interview)*

Her above description of what a student 'needs to know' lists at least five rules and conventions required to solve an equation. Zolani used the phrase "What you need to know is…" often throughout her classes.

Instrumental views of mathematics are not uncommon amongst teachers (e.g. Tan, 2011), as few teachers have had the opportunity to witness genuinely relational mathematical practice in their own mathematics learning (Lloyd, 2002). Given Thandiswa and Zolani's own educational history under the apartheid-era education policy, this epistemology of mathematics is understandable. Teachers' own learning experiences as students have been shown to exert far more influence on their personal epistemologies than their own teaching practice or training (Ball and Wilson, 1990): Zolani provided a clear example of this when she fondly recalled her own mathematics learning experience.

It is important not to dismiss instrumentalist approaches to mathematics entirely (Gates, 2006), as procedures can be a great advantage in learning (Edwards & Mercer, 1987). While relativist, conceptual understanding of mathematics brings about the problem-solving ability for which mathematics is often lauded, even the most advanced of mathematicians

[20] 'BODMAS' (**B**rackets-**O**f-**D**ivision-**M**ultiplication-**A**ddition-**S**ubtraction) as a strict ordering is not entirely accurate and this mnemonic has been discouraged in some countries' mathematics curricula (e.g. England). However, it still seems widely used in South Africa.

still rely on algorithmic approaches for routine tasks, and many students pass—or even excel—at school mathematics having learned instrumentally. Instrumentalist approaches to mathematics are problematic when they lack conceptual underpinning, rendering algorithms the embodiment of mathematical knowledge, rather than as convenient shortcuts. Purely instrumentalist thinking is challenged when a problem arises for which the student has not yet encountered a rule or procedure.

There was very little evidence in either Thandiswa's or Zolani's data that suggested the presence of a relativist base on which their algorithmic approaches rested: their descriptions of mathematics in interviews were procedural, as were their explanations in class. It seems reasonable given these teachers' educational histories and the evidence gathered, along with the prevalence of instrumental thinking amongst mathematics teachers in general, to suggest that both had a predominantly instrumentalist view of mathematics.

Beliefs about teaching and learning mathematics

Thandiswa's beliefs about how to teach and learn mathematics matched her epistemological view of what mathematics is: she advocated exercises and drill practice as an effective mechanism for learning mathematics:

> "Like, yesterday I went to their classroom because they are going to write maths on Monday. I told them they have to start from page one, practicing and practicing and then today they could ask me if they have a problem."
>
> *(Thandiswa: Final interview)*

She mostly cited a student's ability to follow an algorithm, or demonstrate knowledge of a mathematical convention, as evidence of mathematics achievement, rather than certain types of reasoning abilities. Zolani's perspectives mirrored Thandiswa's: her idea of a 'good maths student' was one who did ten questions when asked to do five, with a strong focus on drills.

Both felt that learner-centred paradigms such as OBE (see Chapter 1) were good for mathematics teaching, despite their classroom practice being firmly lodged in a teacher-

centred format (see Chapter 5 for an extract that demonstrates this). In this regard, Thompson (1992), Brodie et. al (2002) and Speer (2005) showed how such seeming 'contradictions' can result from teachers recasting new ideas from training into old classroom practices. In particular, Brodie et. al's (2002) research into teachers' adoption of groupwork as a pedagogical strategy in *form* but not *substance* was particularly evident in both Zolani and Thandiswa's classrooms. Given this phenomenon of recasting new information to fit old practice (Thompson, 1992), there was no challenge presented by the OBE paradigm to the teachers' existing practice. This allowed their previous beliefs to act upon their interpretation of curriculum into classroom activity uninterrupted. (For further studies on this phenomenon, see: Calderhead, 1996; Chapman, 2002; Kupari, 2003).

While both Thandiswa and Zolani felt strongly that learning mathematics created opportunities for their students, they also felt that mathematics was simply beyond some students. This indicates a belief in inherent mathematical ability, a position that correlates with traditional/didactic approaches to mathematics teaching and learning (Stipek, Givven, Salmon and MacGyvers, 2001). Zolani expressly connected successful mathematics teaching and learning to a teacher's, or student's, affective disposition, stating that a student's attitude towards mathematics would dictate how 'easy' they found the subject:

> Sara: "If a student comes to you and says 'Ma, ndifuna ukuphumelele ngezibalo zam!' (*Ma'am, I want to succeed at my mathematics*), what do you say to them? 'Well these are things you must do to succeed, to be a good maths student.'…
>
> Zolani: Oh, to be a… I, I, I always tell them that if you want to… to do maths, you have to love it! You have to love mathematics! Don't just do it! Love it! And then you practice, practice, practice every day: not even a day goes by without practicing. You have to practice… (be) dedicated, attend every day, listen, cooperate, then you will never go wrong. Yes!"
>
> *(Zolani, Initial interview)*

Zolani's connection between affect (primarily in the form of attitude) and mathematics learning manifested, both positively and negatively, as a strong belief that she used to explain many phenomena in her classroom[21]. She was especially vocal about her own distress at her students' failure, and the impact of this on her own love for teaching mathematics. For her, there seemed a strong connection between student attainment and teacher motivation. This idea will be revisited when considering Zolani's beliefs about her students and her context.

Thus far I have described Thandiswa and Zolani's beliefs about the nature of mathematics, how to teach it and learn it, and where these beliefs *probably* came from. The analysis supports the findings of other studies: teachers replicate their own learning experiences, and an internal model of mathematics as a body of knowledge affects teachers' notions of how it should be taught and learned (Calderhead, 1996; Lloyd, 2002; Thompson, 1992). I now turn to describing Thandiswa and Zolani's ideas about language and its role in teaching and learning in general, and in mathematics specifically.

[21] In contrast, Philipp (2007) describes some studies that have shown that, while positive student affect matters, the correlation between a positive attitude and high attainment is not strong.

Beliefs about language, and teaching and learning language

While both teachers had a clearly formulated perspective on the socio-economic power of languages, it is interesting that neither of them seemed to position themselves as a teacher of language to their students (see Tan 2011 for a similar finding in Malaysia). Zolani responded 'agree', and Thandiswa responded 'strongly agree' to the statement:

"The burden on English teachers is greater than other teachers because they provide students with their language of teaching and learning."

…on the Likert scale provided during their final interview, indicating that the burden of English fell to the English teacher and hence was less their responsibility.

Thandiswa emphasized the disproportionate 'strength' of English to access economic and educational opportunities, but also subscribed to the notion of additive bilingualism, shown by her statement:

> "I think English is best (for learning mathematics), but it doesn't mean we have to move away from Xhosa."
>
> *(Thandiswa, Initial interview)*

Zolani was of a similar, but subtly different opinion. For her, all languages had value contextually, each with their domain of usefulness:

> Sara: "Do you think all languages are equal to each other?
> Zolani: Mm-mm (no)
> Sara: Why so?
> Zolani: It's depending on, on the environment and which language they use mostly…
> Sara: Ok
> Zolani: And also they won't have the same value
> Sara: Value. So you think definitely how useful a language is…
> Zolani: But they are all useful!"
>
> *(Zolani, Initial interview)*

Zolani's position about the effect of English at Biko Secondary was similar to some of the urban teachers in Setati's 2008 study; namely, that English—or a lack of it—was not the barrier to students' attainment in mathematics. Zolani also expressed the belief that a language could be used for learning even if students did not *speak* it, but could *understand* it, choosing the option "Agree" for the statement: "A student can use a language for learning without being able to speak it". This was one of the few Likert scale items on which she and Thandiswa were in disagreement. Thandiswa strongly disagreed with this statement, indicating perhaps that, while for Zolani, original student contributions and thought were not a critical aspect of the pedagogical process, Thandiswa valued student contributions more.

Barkhuizen (2002) found strong evidence that students from the Eastern Cape like those at Biko Secondary strongly valued English acquisition, and saw learning other subjects *through* English as the means to do this (see also Setati, 2008). Zolani seemed aware of this pressure from students, and positioned code-switching in class as an erosion of valuable English learning opportunity. She also felt code-switching created a dependency on the teacher, as students did not master the skills required to decipher English texts on their own. Thandiswa expressed a similar concern when she described how students depended on her to assist them with textbook instructions, echoing again the findings from Setati (2008).

The pressure on the school and teachers to maximise English acquisition was echoed by some of the inhabitants of Makhaya who had completed their education at Biko Secondary: they expressed frustration that the teachers did not speak in English more often. Zolani had responded to this pressure to improve English at the school by insisting that only English could be spoken in the playground. When that initiative failed, it further re-enforced Zolani's affective view of the students:

> "We tried, one time, I don't know which year, saying that in the school yard, everybody must speak English, because we saw that there's a problem with language, so everyone in the school yard, but yho! They were not cooperating. Uyabon'? (*you see?*) There's no discipline (becomes quite animated) It's not easy to learn to be a good student when there's… you don't have i-discipline. You have to be disciplined!"
>
> *(Zolani, Initial interview)*

Both Thandiswa and Zolani's beliefs positioned them firmly as *mathematics* teachers, transferring the responsibility for students' language learning onto language teachers or the students themselves. I now consider how these beliefs about how language did (or did not) assist them in fulfilling their mathematical roles.

Beliefs about language in the mathematics classroom

Zolani and Thandiswa's beliefs about how language interacts with mathematics in their classrooms is central to the purpose of this study. There are many studies of teachers' beliefs regarding mathematics and teachers' beliefs regarding language, yet there are few studies of them together (Tan (2011) being the only other study I found that tackled this intersection directly). This area of beliefs is represented by the overlap of all three circles at the centre of the Beliefs Area Map.

Thandiswa's stated beliefs about mathematics and language indicated that she felt mathematics has a symbol set and grammar of its own, into which other languages such as English and Xhosa had little input. The next exchange shows how she reveals this perspective when asked a deliberately ambiguous question about whether symbols or English words make a textbook more difficult for students to decipher:

Sara:	"You see they've got a lot of symbolic questions, but the Grade 8 book is a lot of words—do you think that that's what makes it more difficult?
Thandiswa:	mm
Sara:	for the students?
Thandiswa:	I think so ... I think so, in some way

Sara: In some ways? Could you explain that further for me?

Thandiswa: … I always say they are too lazy! Because some of the exercises, as you can see, in this one: it's just 'solve'. You see? just 'solve'.

Sara: It's just a drill?

Thandiswa: Ya, it's just a drilling: in some of the question papers there are questions that are like this and then they can't even move.

Sara: Ok, interesting!

Thandiswa: Mm

Sara: So there's not a language problem there

Thandiswa: Mm-mm (no) in some of the questions there's not a lot of languages. (I) think, the only… the only learners who have a problem are those who sit mathematical literacy … because maths lit., there's a lot of wording. They have to analyse the question first before calculations. But in pure math?

Sara: There's more symbolic representation?

Thandiswa: There's more symbols."

(Thandiswa, Initial interview)

Thandiswa predominantly identified language as a barrier to her students' mathematical performance in written assessments: the more 'words' in a test question (compared with symbols), the more challenging the question's interpretation. She admitted that even teachers struggle to decipher questions in exams, but felt that this difficulty with written words did not account for her students' struggles in class. However, she also admitted that she struggles to pinpoint her students' misconceptions, as they do not ask for help as much as she would like:

Sara: "Do you feel like your, one of your biggest challenges as a teacher is getting the students to show you where their problems are?

Thandiswa: mm (yes)

Sara: So you're actually just… you look at them and you think "well, I actually don't know how to help you because I don't know…where your /problems are/"

Thandiswa: /what you/ don't have, what you don't know". They have to ask! They are ask… I mean, they are not asking!"

(Thandiswa, Final interview)

Thandiswa seemed relatively certain that language was not a problem in classes, only in tests, but it was difficult to ascertain on what evidence she was basing this assertion. She made her position particularly clear in her initial interview:

Sara: "People say that maths is not words, maths is symbols. (pause) Do you, do you agree with that?

Thandiswa: I agree with that.

Sara: You agree with that?

Thandiswa: mm (yes)

Sara: Ok, so you don't think…

Thandiswa: Maths is not words.

Sara: It's, it's symbols?

Thandiswa: mm (yes)"

(Thandiswa, Initial interview)

Thandiswa's belief stated in the above extract is further explored in Chapter 5 when an extract from her class is analysed, where it becomes apparent that the words are causing some difficulty for students, but are invisible as an object of teaching and learning in the class.

When choosing the spoken language of teaching and learning in the mathematics classroom, both Thandiswa and Zolani felt code-switching between English and Xhosa was a necessary evil, with English being 'better' for teaching mathematics due to the limited mathematics register in Xhosa (Setati and Adler, 2000).

Both teachers recognised the inadequacy of a standard dictionary for deciphering terms specific to the mathematics register. But while Thandiswa was conflicted about whether the

mathematics register was indeed different to other content-based subject registers, Zolani had a sense that there was something different about 'talking mathematics', although she was unable to formulate what exactly that difference was.

Dilemmas in multilingual mathematics classrooms

Neither Thandiswa nor Zolani felt that Adler's "dilemma of code-switching" (2001) was salient, since the notion of 'language role model' was absent from their sense of what mathematics teachers do: Thandiswa made it clear that modelling good English was not a priority for her in maths class—she just needed to get the idea across to her students. Zolani felt language modelling was an unnecessary hindrance. While code-switching was *present*, it did not present a *dilemma* for these teachers:

Sara:	"Do you think that there's right ways and wrong ways to use language? So, like code-switching… sometimes you might say 'oh but that's not real Xhosa!' That's not real English…'
Thandiswa:	mm
Sara:	Do you agree with that? Or do you think… do you just use what you can and you get on with it?
Thandiswa:	I just use what I can
Sara:	… and get on with it. Mm, so it's not really important
Thandiswa:	It's not important, I don't think it's important."

(Thandiswa, Initial interview)

The "dilemma of transparency" was also not apparent, as neither teacher felt that language should be an explicit object of teaching and learning in the mathematics classroom. The "dilemma of mediation" did not manifest, since the teacher-centred, didactic approach exhibited by both Thandiswa and Zolani kept student responses short (see Chapter 5), without the need for students to formulate and express mathematical ideas.

Given that both teachers had similar experiences of mathematics education to their students regarding their LoLT, I pursued a line of inquiry about their sense of empathy with their students on this challenge. Zolani's own struggles as a student learning in her second or third language did not translate into solidarity or empathy for her current students.

Thandiswa was slightly more sympathetic, but only regarding students' struggles with the deciphering of written texts in English, as opposed to mathematical symbolic representations. This finding echoed Pettit (2011)'s study in the United States, where multilingual teachers' empathy for ELL students was no different from that of their monolingual counterparts. In Pettit's study, teachers' empathy decreased over time, perhaps explaining Thandiswa's slightly softer stance in relation to Zolani, who was the longer serving teacher. These two teachers believed that if *they* could succeed in learning mathematics through English as a Xhosa speaker, so could their students.

This last aspect of Zolani's and Thandiswa's beliefs, namely their attitudes towards their students, manifested repeatedly as strong, affective beliefs from both of them (more notably Zolani). Given their recurrence during the data collection process, I decided to pursue this set of beliefs more formally, which is what I turn to next.

Beliefs about teaching and learning in general, and the students of Biko Secondary

> "Teachers beliefs' played a major role in the types of activities they chose and designed, and *the ways in which they evaluated the motivational behaviour of their students.*" (Middleton, 1999, p. 349) (my emphasis)

We have established that Thandiswa and Zolani have specific beliefs about what mathematics is, and that this most likely transfers into the types of activities and learning opportunities they create for their students. However, another set of beliefs is also at work when selecting (or ignoring) teaching activities and processes: what the teachers believe the students are capable of (Beswick, 2004). Throughout the data collection process, it became apparent that the two teachers had strong, central beliefs about their students. In order for this study to maintain credibility in the accuracy of its portrayal of Thandiswa and Zolani's beliefs, it must detail these beliefs alongside those already described.

This set of beliefs is particularly interesting as it represents the most co-constructed of all the beliefs so far: who the teachers think their students *are* will be tightly located in their classroom interactions, where student behaviour reifies certain beliefs that may not be true elsewhere in another context. Teaching is, itself, inherently a learning process (Lloyd, 2002) and teachers are learning who their students are, and what they are capable of, lesson by lesson. Zolani and Thandiswa's beliefs differed somewhat in this area of the Beliefs Map, so I will discuss them individually.

Zolani

Zolani's beliefs about her students were the strongest opinions she expressed throughout the study. Her utterances about her students in interviews were often her longest and unprompted, indicating a deeply affective set of beliefs that were a source of much concern for her. The following extract from her first interview reveals her frustration:

> "Because I love mathematics neh! Most of the teachers didn't want to come to the rural areas. And I said 'yhu, I want to teach them! I want the rural kids to have this information.' I was confident then! I was new, with no experience but just the love. But now, I'm experienced. We're getting a

> lot of workshops, everything! I'm even a cluster leader! I'm getting more information from my subject advisor. I'm also teaching at her project, _____. So they… they are doing workshops for us. I'm getting more and more, but my learners? Nuh-uh! I don't know, I don't know… I don't know what went wrong."
>
> *(Zolani, Initial interview)*

Zolani's deep-seated belief was that her students were intrinsically and fundamentally unmotivated to learn mathematics. When asked about topics specific to maths pedagogy or language use, she would frequently fall back to her central belief: that the students are 'lazy'.

To summarize Zolani's perspective so simply ignores some of the more complex beliefs about her students that she revealed in other, less emphatic, ways. She independently cited present day challenges for teenagers that she did not have to face, in particular technological distractions from schoolwork in the form of cellular phones and social networking. She also expressed that, from her perspective, the community of Makhaya was unsupportive of the teachers at Biko:

> "The community doesn't like teachers because, hey we don't feel protected. They don't love us."
>
> *(Zolani, Initial Interview)*

She also stated that many of her students lacked structure at home (a perspective shared with Thandiswa). However, when pushed to further explicate these positions, she always returned to the original point: that students' lack of understanding and progress at school was primarily due to their work ethic and their unwillingness to engage in class or complete homework.

Zolani's central belief about her students' motivation manifested in other behaviour patterns. She was, for example, absent more often than Thandiswa. When present at school, she sometimes missed lessons or performed other duties during lesson time, distributing her attention between teaching and other tasks. This might be because she felt

the loss of lesson time would not make a significant difference to her students' outcomes, since they were struggling to learn anyway and—to her mind—not engaged in learning. She also felt that corporal punishment had a place when students did not do their work, although she admitted that she felt uncomfortable demonstrating this to an outsider[22]. Zolani could recognise a lack of confidence in asking questions amongst her students, but she primarily attributed this to peer influence and laziness, and not to fear of punishment. It is conceivable that she believed such disengagement on the part of her students required a 'strong response'.

These two examples of potentially problematic aspects of Zolani's approach to her students—while not necessarily agreeable—become more comprehensible in the light of how strongly she felt about their dispositions and her beliefs about their agency, or lack thereof.

Thandiswa

It became apparent while working with Thandiswa that she had conflicting views about her students. She would often explain students' behaviour or difficulties by positioning them as 'lazy', and yet recognised that some were keen to work.

Like Zolani, Thandiswa contrasted her own schooling experience with that of her students by the use of the word 'discipline', as can be seen in the following quote from her initial interview:

Thandiswa:	During that… at that time, discipline was instilled in us. So you have to do your homework and at home you have to… your parent have to see that you are taking your books…
Sara:	Ok, and, and your parents checked on you?
Thandiswa:	Mm (yes!)
Sara:	Very strictly?
Thandiswa:	The parents did check.

[22] It should be noted that while corporal punishment is outlawed in South Africa, it is still practiced covertly in many ex-DET schools, both urban and rural.

Sara: Mm ok… do you think that is now still the case?

Thandiswa: Mm-mm (no), because I don't they are being observed.

Sara: Ok they're not… there's no kind of …support at home?

Thandiswa: There's no support!

Sara: For what the teacher's doing?

Thandiswa: Mm-mm (no).

Sara: Ok… why do you think that is?

Thandiswa: I think, um, you see here, some of the learners are staying with their grandparents. They are old. I think there's that's a problem. Their parents are staying maybe in Johannesburg. They are in towns, their parents. Some of them are staying alone!

(Thandiswa, Initial interview)

Thandiswa's foregrounding of the home environment alludes to her beliefs about the importance of environmental factors when assessing students' motivation and achievement at school (a belief supported by the findings of Fleisch (2008) amongst others). This is further evidenced in the following extract from Thandiswa's stimulated-recall interview, where she was invited to share more knowledge about her students as the camera panned the classroom:

Sara: Tell me about them… Strong? Weak? Just lazy? Or actually they work hard but they struggle?

Thandiswa: Ya, they are really trying … they are trying.

Sara: They are trying hard? Are they, are they reaping the results?

Thandiswa: They are really keen to do the work. But the only problem that these learners ha-have, is just not practicing at home. They are only practicing when they are in class. And then you can see they are… they do want to learn.

Sara: Mm, so they are keen in class?

Thandiswa: Ya! They are keen in class.

(Thandiswa, Final interview)

Thandiswa felt that missed class time was lost learning time—she was certainly one of the more present teachers in the school over the period of the study. She also recognised the disruption in learning for students who had to move schools or repeat years. Her statement regarding students in her class over the cohort age threshold was striking: "this is their school… they have to be here" *(Thandiswa Final Interview)*. Despite often labelling students as lazy, Thandiswa showed a genuine warmth towards her classes, acknowledging their fears about learning or being exposed as 'not knowing', and creating space in her lessons for joking and laughter (although she did not wish to appear 'soft'). She identified a lack of student confidence as a key barrier to learning, and used peer support and 'groupwork' to attempt to address this. She also avoided directly rejecting a student's idea outright in class, in order to build their confidence.

Thandiswa made it clear that she felt her students' results did not reflect her efforts, and that this had a negative impact on how she was viewed by the students and the community, as they held her accountable for her students' attainment. And yet, she felt she still had a strong influence in her students' lives, despite their poor performance in assessments.

It became more and more apparent that Thandiswa had a sense of the environmental factors holding her students back—factors outside of her control (Wenner, 2001). It is conceivable, given that she felt powerless to change her students' outcomes, that she perhaps resorted to the common theory of the staffroom espoused by her peers: that the students are lazy and this explains their poor performance at school. Thandiswa's other beliefs, however, revealed that she does not entirely share this deficit view of her students with her colleagues.

Conflicting evidence

Evidence presented itself during this study that the students of Biko Secondary were not always what could be considered as stereotypically 'lazy'. One counterpoint to the laziness narrative was that students arrived to school on time daily for an 8am start, despite lessons frequently starting late. When asked about this issue, Zolani countered that students were 'present, but not engaged' (this distinction was hard to identify during classroom observations, as conversation was heavily biased towards 'teacher-talk'). Students also

performed many functions at the school that could be considered unusual to some observers: cleaning, making tea or doing hair for teachers, functioning as librarians, or assisting the secretary with filing. For the most part, students were certainly actively participating in some form of task or activity, whether in or outside class. Both Thandiswa and Zolani stated that the students' behaviour during classroom observations was not markedly different from the norm. Why, then, the strong views that students are 'lazy'?

Both teachers

Wenner's (2001) findings regarding teacher motivation and locus of control provide a useful lens to make sense of Zolani and Thandiswa's underpinning theory of 'lazy students', despite evidence to the contrary. In studying the locus of control for practicing and prospective maths and science teachers, he found that teacher locus of control affected self efficacy: "In effect, we do what we believe we can do" (Wenner, 2001, p. 181).

There can be no denying that the socio-economic and linguistic odds are heavily stacked against Zolani and Thandiswa's students, where poverty affects school attainment in a myriad of ways (see Fleisch, 2008) and formal assessment occurs in a language that is effectively foreign. These contextual factors inhibiting the learning of students at Biko would very much frustrate any teacher's efforts. If presented with poor results despite genuine efforts, as Zolani explicitly stated, it is entirely understandable that a teacher begins to locate the locus of control over her students' results outside of herself. The result is a loss of self efficacy and changing beliefs about her efforts, her students and her work towards a negative outlook. Zolani explicitly stated that her love for her work was dependent on her students' results, and with the decline in marks her love for her work diminished. Given that Biko's results were extremely poor and have, according to the teachers, been declining year-on-year, Zolani's beliefs about her students become comprehensible as a psychological survival mechanism; an acceptable, albeit bitter, explanation as to why her efforts have not borne fruit. Such a belief would potentially be held centrally, as many others depend upon it, and hence be difficult to change (Green, 1971).

Wenner (2001) described teachers' concern about a loss of 'prestige' when operating in teaching and learning spaces where their locus of control was external to themselves. This idea captures Zolani's beliefs well:

> "They are letting me down. You know? They, they are spoiling my credentials. You know? I used to have good results! But now I, I don't know. Every year it is deteriorating instead of going up."
>
> *(Zolani, Initial interview)*

Zolani is clearly disturbed about the impact of her students' poor results on her reputation and credentials—perhaps she even worries that she may struggle to find alternative work as a result, locking her into her current position at Biko. Affective beliefs such as these are often central and subconsciously held (McLeod, 1992).

Disconcertingly, once a teacher begins to believe in certain deficit views of her students, her beliefs begin to construct those students' beliefs in themselves: Hardré & Sullivan (2008) showed that teacher characteristics predicted student motivation and self-perception far more than peer influences. *How* a teacher thinks a student *is* plays a large role in how that student performs and the identity they enact in class. Thus, teachers' deficit beliefs about their students become self-fulfilling prophecies, further reinforcing their position.

Reversing this rather unfortunate state is not as simple as merely asking teachers to 'believe in their students'. As mentioned previously, beliefs need to be couched in context (Green, 1971; Philipp, 2007; Thompson, 1992). It is necessary to consider this context in which beliefs have been formed and how that context has—or has *not*—changed, when examining how beliefs might lead to pedagogical change (Chapman, 2002).

It is quite conceivable that both Zolani and Thandiswa rely on their deficit beliefs about their students as a mechanism of surviving and *externalising* their locus of control in an extremely challenging environment. Not only does the belief that students are lazy and disinterested in education allow them to inwardly explain the lack of results for their efforts to themselves, but it also provides external justification to others who would hold them accountable for factors over which they have no influence. These 'others' could include parents, the

Department of Basic Education, even each other. For Thandiswa, there was a strong sense that she felt less comfortable with this belief about lazy students, but felt it necessary to uphold as a belief constructed communally and in solidarity with her fellow teachers—a rural school is not a place to isolate yourself from your colleagues. In this manner, strong central beliefs that have significant consequences for pedagogy are constructed and affirmed collectively amongst teachers, with very little scope for being challenged by any individual.

In addition, if one subscribes to the idea that mathematics is a socially constructed activity (Cobb, 1986; Gates, 2006), then beliefs about the students and their abilities feed deeply into the willingness to design and engage with open-ended, collective mathematical problem solving and discussion, and inquiry-based instruction (Lloyd, 2002). In this manner, Thandiswa and Zolani's beliefs about who their students are can also be seen as evidence regarding their classroom practices mathematically.

Conclusion

My synopsis of Thandiswa and Zolani's beliefs has come full circle: the last area of beliefs regarding how the teachers view their students casts our eye back to the types of activities and learning opportunities they believe are appropriate for learning mathematics.

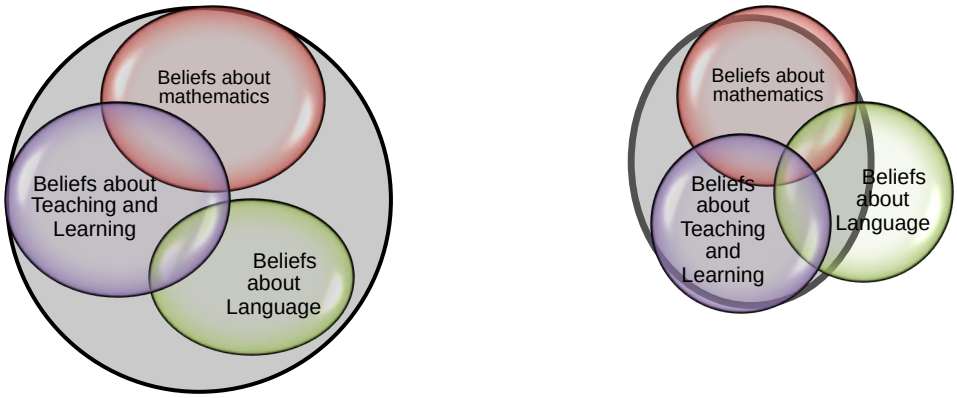
Both teachers shared many beliefs across areas, and yet subtle distinctions manifested that could have significant implications for how *change* in beliefs might be effected for either Thandiswa or Zolani.

For Thandiswa, her beliefs about how language interacts with mathematics, and how it is taught and learned, became stuck on the idea that symbols do not require words for interpretation: that mathematics is primarily a written discourse and hence considerations of spoken language are not an issue.

For Zolani, language was not an issue in the mathematics classroom because student motivation explained all issues satisfactorily; the consideration of language as an object of learning in her maths teaching would not result in any significant improvements for her

students because their problem was motivational, not linguistic. Her deficit view of her students dominated all her other opinions, constricting alternative explanations.

If we consider how we might alter the Belief Area Map to graphically represent these subtle distinctions, Zolani and Thandiswa's belief maps might look something like the following:



Thandiswa Zolani

Figure 3: altering the original Beliefs Area Map to visualize individual teachers' belief systems. Thandiswa's shows no overlap between mathematics and language, reflecting her focus on symbolic, written representation. Zolani's shows the domination of beliefs about her students (the 'Context' circle is thicker and restrictive) obscuring beliefs about other issues.

Such subtleties provide justification for efforts to investigate teachers' beliefs across multiple areas of their work. A cursory query about whether teachers believe language matters or not in their classroom would not reveal these variations, manifesting in a surface answer that does not explain how the belief has come about, or how it continues to be justified. If beliefs occur in clusters and systems, these forms of interconnectivity amongst beliefs must be understood in order to present appropriate, yet challenging, evidence so that a teacher might critically re-examine what she believes.

In the next chapter, I examine an extract from Thandiswa's classroom using classroom discourse analysis for further evidence about her beliefs, as well as what dilemmas or challenges may be presenting themselves in the classroom that are potentially obscured by her beliefs.

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Chapter 5: Classroom observations—beliefs in action

Introduction

In this chapter, an extract from one of Thandiswa's lessons is examined using discourse analysis to:

- provide further evidence for the claims made in Chapter 4 through the analysis of speech not directly discussing beliefs, and
- connect the attributed beliefs gained from analysing the interview data to classroom activity, in order to understand how these beliefs might manifest in every day teaching and learning.

In the extract examined, a challenge presents itself to the teacher, which can be located in the central area of the Beliefs Area Map: a difficulty in class around teaching and learning mathematics through a second language. The extract was chosen for two reasons. Firstly it represented many aspects of the teacher's classroom practice that had been exhibited across all observations. Secondly it presented a pedagogical challenge that illustrated key beliefs identified in Chapter 4.

An extract from Thandiswa's teaching of algebra: the transparency of language

In this algebra lesson, Thandiswa revises the terminology involved in identifying different algebraic expressions. The following extract shows the first four minutes of classroom discussion as she tries to elicit previously learnt information from the students.

The classroom dialogue shows four clear sequences: each sequence is described below, analyzing Thandiswa ('Tha')'s questions and how students respond. (Chorusing from many students is denoted as 'SS'. Individual students are assigned pseudonyms. For further transcription notation details, see Addendum G).

After all sequences have been described closely using classroom discourse analysis, the implications of this analysis for Thandiswa's beliefs are discussed.

Sequence 1

1. Tha: *(writes the title "Algebraic Expressions" on the board and underlines it)*
   Algebraic expressions… suppose you are given / 12sec /
   (*goes up to the board and writes '5x'*)
   Zingaphi ezi (how many are these)? *(points at the expression on the board)*
   \can't hear next bit as a student is scraping a desk on the floor\ ntoni? (what?)
2. SS: One
3. Tha: And then xa une-one term kwi-polynomial
   (when you have one term in a polynomial),
   what do you call that expression?
4. Sipho: \indiscernible\
5. Tha: Hm? zingaphi ezi-terms? (how many are these terms?)
6. Sipho: It's a binomial
7. Tha: *(to the whole class)* Is this a binomial? *(refers to the '5x')*
8. Anele: No, it's a monomial.
9. Tha: so it is a? monomial *(writes 'monomial' next to '5x')*

Thandiswa's first line stands out from the rest of this sequence. She starts by using a style of speech that is specific to the mathematics discourse in English: "Suppose you are given". This opening phrase is predominantly used in mathematics to provide a set of assumptions or axioms required for a proof or problem solution, rather than a naming activity. It signals to the reader that the mathematical assertions that follow should not be questioned and can be taken as 'certain'. Students will normally encounter this phrasing in formal written assessments, and perhaps Thandiswa is attempting to expose her students to mathematical ways of speaking, but its use here does not accurately convey to the students its precise mathematical usage or meaning, nor that it is inappropriate for signalling the start of the naming activity that follows.

The next utterance moves back to the every day home language register with her Xhosa question "how many?", in a manner similar to that described in Setati et. al (2002). Thandiswa then scaffolds the students' chorused response in line 2 into the next turn, "when you have one term, what do you call that expression?", thereby reminding students about using the cardinality of terms in an expression to correctly *name* that type of expression, and indicating that this activity is indeed a naming activity.

The Xhosa used in line 3 is the matrix language into which unexplained mathematical ideas such as 'term' and 'polynomial' are inserted. At this point, it may be fair to assume that the unpacking of these terms has occurred prior to this class, but I show in later sequences that Thandiswa is problematically assuming that students already understand some of the mathematical words she uses.

It is worth mentioning that these naming conventions of algebraic expressions are good examples of Ernest's instrumental model of mathematical 'facts to be memorized' that do not necessarily relate to problem-solving ability. Nonetheless, these 'facts' are specified in the curriculum: if Thandiswa has the instrumental mathematical epistemology suggested by her interviews and observations, this excerpt demonstrates how, in this case, the *curriculum* is reinforcing her model of mathematical knowledge.

It would seem Thandiswa heard Sipho in line 4 and repeated her first question in Xhosa to indicate that Sipho's initial suggestion wasn't correct. This is common in classroom discourse where teachers repeat a question if they have not received a satisfactory answer (Cazden, 1988), even though the question may not give any additional information to assist the student in ascertaining what that desired answer *is*. Sipho gives an incorrect answer in line 6, and Thandiswa moves to the rest of the class for clarification that his answer is not correct. Anele then gives the correct answer, and Thandiswa affirms his response through repetition.

The absences in this sequence are notable: Sipho was clearly unsure of the meaning of 'binomial', but Thandiswa does not explicate why the answer 'monomial' is correct and 'binomial' not. Nor does she ask Sipho for his reasoning behind responding 'binomial'. The Initiation-Response-Evaluation (IRE) cycles demonstrate a closed questioning pattern led by teacher-talk, wherein students need to guess the answer that the teacher wants. For Thandiswa's first question (line 1), which involved simply counting terms, this was a

relatively simple task. The second question (line 3), which involved recollection of mathematics terminology based on some criterion, was not so easy[23].

The second sequence below followed directly after the first with no interval. Interestingly, the teacher's move of providing an expression and asking for its 'name' is inverted. In this sequence, Thandiswa asks for *examples:* students are asked to construct their own expressions. This inversion is significant, as it deviates from the closed questioning of the first sequence—in fact, this sequence is the only example across all observed lessons with all teachers at Biko Secondary (a total of 10 hours teaching time) in which students were asked a question that had more than one correct answer. Thandiswa expressed beliefs about students needing to build confidence and not be constantly corrected in her interview, and this next sequence shows how she attempts to do this in her class.

Sequence 2

10. Tha: Can you give me an example of … of the second expression? / 16sec /
11. Zukisani: two x plus three x
12. Tha: So two x plus three x *(writes '2x + 3x' on the board)* / 6sec /
but this one: zintoni ezi? (what are these?) *(points to the '2x' and '3x')*
13. Noxolo: Zi-like terms (They are like terms)
14. Tha: These are? ii-like terms. And then when you are adding like terms you can use two x plus three x meaning we have ubani? (who?) who?
15. Sisipho: (indiscernible)
16. Tha: nina! (you!) *(referring to a table of students where Sisipho is seated)*
17. Sisipho: five x.
18. Tha: five x. (*writes '5x' on the board*) So iza kwenza ntoni?
(So it will make what?) a? monomial!
(draws an arrow to the word 'monomial' from '5x')…
Give me again in terms of x whereby we say uthi i-expon… i-expression ezi…
(it's an expon… an expression which…)
19. Anele: five x plus five
20. Tha: hmm?
21. Anele: five x plus five
22. Tha: so five x plus five … so five x plus five. *(writes '5x + 5' on the board)*
And then what type of, eh, expression is that?
23. Bonke: a binomial
24. Tha: a binomial. It is a? binomial. *(writes 'binomial' next to '5x + 5')*

[23] It should be noted that Anele is probably the strongest student academically in the class and one of the most vocal throughout all observations.

Thandiswa opens up the discussion more here by asking for students' own constructed expressions. In keeping with her expressed beliefs about not rejecting students' ideas outright, she writes Zukisani's idea on the board[24]. She then implies there is an issue with Zukisani's idea when she starts 'but this one…', initiating a new IRE cycle by then asking in Xhosa again "what are these?", and Noxolo gives the answer she wants.

At this point Thandiswa does not use the opportunity to refine the definitions of the expressions she wants. She implicitly imposes the criterion that an expression *cannot contain like terms* i.e. it must be simplified as far as possible when the number of terms in the expression are counted, but this criterion is never made clear in either English or Xhosa.

Line 18 potentially causes confusion for the students. Thandiswa states 'give me again *in terms of x* whereby we say it is an expon… expression which…". She is attempting to model a mathematical register again when she uses the phrase 'in terms of x'. This phrase is often used to indicate the form in which a solution to an algebraic problem must be presented: a value is expressed using only the variable x and constants. However, in this situation, the word 'term' already means something else: a component of an algebraic expression. This overloading of the word 'term' could potentially be confusing for learners for whom English is effectively a foreign language (see Chapter 1).

Thandiswa is also herself potentially confusing English mathematical nomenclature, beginning with 'ex-' when she starts saying 'exponent' and then corrects herself to say 'expression'. While it is wholly unreasonable to expect that a teacher should never make a mistake, this small error demonstrates how easy it is to confuse seemingly similar terms with very different meanings.

In lines 19 and 21, Anele, gives an example, and Thandiswa seems satisfied that the notion of a binomial has been contrasted with that of a monomial. In the next sequence, another student, Sive, attempts to replicate Anele's pattern for a binomial by modifying Zukisani's

[24] I infer from her question in line 10 that 'the second expression' is one in which the polynomial contains *two* terms instead of one: it is worth mentioning that Xhosa as a language does not use articles 'a' and 'the', and many Xhosa speakers operating in English struggle with these. I hence do not interpret any significance to Thandiswa's use of 'the' in this statement.

offering "2x + 3x" to look more like "5x + 5". Unfortunately, as we will see, this co-construction of understanding is not noticed by Thandiswa and, although she does not reject Sive's offering, she still does not refine the definitions of the expressions by drawing on the similarities between the two binomials offered.

Sequence 3

25. Tha: Another expression! Another type of an expression. What would you call another type?
26. Avuyile: \indiscernible\
27. Tha: uhuh?
28. Avuyile: \indiscernible\
29. Tha: *(ignores Avuyile's statement and turns back to the class)* another type of an expression …
30. Sive: three x…
31. Tha: three x? *(writes '3x' on the board)*
32. Sive: plus two
33. Tha: plus?
34. Sive: two
35. Tha: plus two *(writes "+ 2")* … so if three x plus two what type of an expression is this?
36. SS: binomial
37. Tha: so it is a?
38. SS: binomial
39. Tha: binomial *(draws an arrow from '3x + 2' to the word 'binomial')*

Sequence 3 starts by again inverting the question direction back to that of Sequence 1: Thandiswa is looking for terminology again ("what would you call another type?"). Avuyile's offering clearly does not fit any criteria that Thandiswa will accept, and although she does not refute what the student said (unfortunately indiscernible on the video) outright, she clearly demonstrates her control of the conversation by repeating her question again to the rest of the class in line 29 and not responding at all to Avuyile's statement.

Despite being asked for terminology, the students seemed to respond positively to the idea of constructing their own examples, and Sive does just this. He refines Zukisani's offering from Sequence 2 by dropping the variable 'x' from the second term, thereby making it appear more like Anele's successful expression. Although Thandiswa asked for 'another type', she accepts Zukisani's expression, and uses the opportunity to reinforce the word 'binomial' as evidenced by the whole class chorusing in lines 36 and 38 with her.

At this stage, there is still no unpacking of 'like' versus 'unlike' terms, and the opportunity to draw comparisons between "3x + 2x" (line 11) and "3x + 2" (line 35) is missed. The absence of unpacking could be attributable to this being a revision of a previously covered topic. However, sequence 4 reveals that some students are still not clear on the criteria required for polynomials, and that unpacking is indeed required. Once again, Thandiswa is looking for a different type of polynomial (and seems happy to accept either a name or an example), and a student constructs an expression that contains three terms, but they are all like terms again.

Sequence 4

40. Tha: Give me another type!
41. Onele: three x! … *(Thandiswa points to Onele that she should answer)*
three x … *(Thandiswa writes '3x')* plus five x … *(Thandiswa writes '+ 5x')*
minus two x … *(other students begin to laugh)*
42. Tha: We are having x's again which means we go back siba nantoni? sibe ne-?
(We are with what? We have-?)
43. SS: (murmuring)
44. Tha: sibe ne-? (we have a?) monomial
45. SS: monomial
46. Tha: because? eza terms zintathu ndenza ntoni? zi-like terms!
(those terms are 3 in number I can make what? They are like terms!)
Meaning we can add them together! … So suppose uno- (you have)
let's say three x squared plus five x minus two. *(On the board, Thandiswa alters Onele's offering from 3x + 5x -2x into $3x^2$ + 5x -2)*
So three x squared plus five… plus five x minus two meaning zi-terms ezi zingaphi? (these terms they are how many?)
one-two-three! *(Thandiswa moves her hand over each term as she counts)*
47. SS: one-two-three!
48. Tha: And then ezi terms zintathu (these terms are 3 in number) what do we call that type of an expression?
49. SS: trinomial
50. Tha: called a?
51. SS: trinomial *(Thandiswa writes trinomial on the board*).

Towards the end of the fourth sequence, Thandiswa seems to lose patience a little and then tells the students the answer she is looking for, without addressing the problem of unlike terms as part of the definition of these polynomials.

It is clear from this sequence that the students have caught on to the criterion of cardinality to identify different types of algebraic expressions: given an expression with one term in Sequence 1, they go on to provide examples with two and three terms respectively. They have also clearly encountered the notion of 'like terms' before but these ideas are not being connected to construct a richer understanding of what monomials, binomials and trinomials—or polynomials in general—*are*. Throughout the whole episode, Xhosa is only used as a matrix language, with mathematical terms remaining unexplained. Ideas such as 'term' and 'polynomial' are almost held to be self-explanatory through their symbolic representations on the board, and are not dealt with explicitly. The potential for exploration in sequences 2 and 3 is allowed to fall back into closed questions and multiple student chorusing of single-word answers in lines 45, 47, 49 and 51.

What does this tell us about what Thandiswa believes?

In Chapter 2, I made a case for the suitability of discourse analysis for examining beliefs. Having described Thandiswa's lesson carefully through classroom discourse analysis above, I now refer back to the Beliefs Area Map as a guide to discuss what this extract tells us about what Thandiswa believes.

Beliefs about the nature of mathematics, and how to teach and learn it.

It would be unfair to use this extract alone to accord to Thandiswa an instrumentalist model of mathematics: rather her suggestions, through her interviews and her approach in this observation, and others, provided a convincing body of evidence about how she sees mathematical knowledge (see Chapter 4). What is significant about this lesson topic, and many of the others Thandiswa covered during the study, is how this topic (names of algebraic expressions) in the mathematics curriculum implicitly encourages the belief that mathematics is indeed a set of rules and definitions to be memorized[25]. Thandiswa's internal model of what mathematics *is,* then, is not only then constructed by her own experience of learning mathematics, but also by the constraints that the existing Grade 9 mathematics curriculum imposes on her classroom.

[25] The other lessons observed covered "averages and range", and "stem and leaf diagrams", both parts of the Data Handling module of the curriculum, and also topics that require memorization of conventions and 'facts'.

Beliefs about the students, and about teaching and learning in general

Thandiswa demonstrated her slightly warmer relations with her students in this extract. At no point did she outright refute or reject a student's offering, and the amount of take-up time provided was in some cases significantly longer than in other observed lessons (e.g. lines 10 and 12). Her strongest admonishment in the class was relatively mild, evidenced in line 16 ("Nina!"). This, combined with her open question in sequence 2, and willingness to accept examples through sequence 3 (even though they did not entirely match what she was looking for), provides further evidence of an orientation towards her students that is perhaps more receptive than Zolani (See Chapter 4).

Beliefs about language in the mathematics classroom

Perhaps most notably, the extract examined here also provides a rich body of evidence on Thandiswa's beliefs about language in her mathematics classroom. She does indeed code-switch when she feels it necessary, but at no point are difficult concepts unpacked, or explanations given in Xhosa, to assist understanding. Words such as 'term', 'like' and 'unlike' remain opaque and are not identified as needing attention, even when it becomes apparent that students are grappling with making meaning from them.

This lesson simultaneously confirms and problematizes Thandiswa's belief that mathematics is 'symbols, not words'. Her focus on the written form of mathematics manifests in her attempts to model the formal wording of mathematics questions as they appear written in assessments ("suppose you are given" (line 1) and "in terms of x"(line 18)); at times, she uses these phrases inappropriately without explicating their meaning in an 'everyday' register.

However, the absence of exploration of other mathematical language, such as "like terms", indicates a challenge in meaning-making that seems invisible to Thandiswa. It is almost as if her focus on mathematics as a written practice, in which rules are applied and facts memorized, *obfuscates* her ability to see the barrier that individual words and phrases are erecting to her students' construction of *meaning*. Meaning-making as a practice does not have much space in a world where facts are facts and rules are followed, and hence perhaps

unpacking of strange terms and phrases is not deemed necessary to mathematical 'understanding' in an instrumentalist sense.

Language as an object of study does not feature in this extract, nor in the other classes observed, and Adler's dilemmas are not present: Thandiswa did not evidence any uncertainty about code-switching, mediating her students mathematical language, or making language the object of study in the class. As stated in her interviews, it was taken-as-given that mathematical words and phrases are self-explanatory through their symbolic representation.

Tan's description below of teachers who view language as a conduit describes Thandiswa's beliefs well:

> "Teachers' dichotomous beliefs of language and content is problematic for both the content learning and language learning domains. It leads to a view of language as a conduit or portal, thereby obscuring the role that language plays in construing the subject" (Tan, 2011, p. 336, drawing on Barwell, 2005).

Having examined Thandiswa's beliefs in detail and found them to closely match Tan's description, I would posit a further question: is holding an instrumentalist mathematical epistemology fundamentally at odds with admitting language as a key consideration in mathematics teaching and learning? Can language be anything *but* a conduit when the objects of learning are fixed rules and procedures? Certainly Thandiswa's data provide reason to suspect a relationship between these two seemingly disparate beliefs.

Conclusion

This chapter examined a short excerpt from Thandiswa's classroom that provided a rich insight into her beliefs and how they manifest in her teaching. The use of classroom discourse analysis was productive for 'colouring between the lines' of her belief portrait outlined in Chapter 4 and providing further evidence for the beliefs described.

Chapter 6: Conclusions and recommendations

Overview of the study

I began this dissertation with the precept that teacher development programmes in South Africa are not having the desired outcomes. I then posited the examination of teachers' beliefs as a potential approach for teacher training practitioners to consider when designing programmes for teachers.

After problematizing some of the literature's definitions of beliefs, it became apparent that a loose, broad definition of beliefs encompassing attitudes, values, knowledge and affect would better enable understanding what teachers think about their work and the epistemological models they bring to bear in their classrooms. I presented a significant body of evidence as to the connection between teachers' beliefs and their classroom activities, giving further weight to the premise that teacher beliefs might play a pivotal role in enacting change in teaching practice.

Multiple methods were used to collect rich data, over a period of a month, about two mathematics teachers working in a secondary school in a rural village located in the Eastern Cape. The data included multiple interviews, multiple observations and secondary information about the school, the village, and the researcher's position in the space. The result was a large amount of data that yielded detailed portraits of the teachers' views on their work, in their world. In particular, the interaction of beliefs about teaching and learning, mathematics, and language formed the central axis of the investigation, a combination precipitated by the challenge of language in South African rural mathematics classrooms.

While the findings for these teachers echoed the findings of other studies regarding their beliefs about mathematics teaching and learning, the role of language in their classrooms, and who their students are, it became clear that even though the two teachers may superficially hold the same beliefs, their reasons for holding those beliefs were subtly different. Both felt language was not an issue specific to the mathematics classroom, but

exploration of their other beliefs, combined with the view of beliefs as interconnected, revealed different justifications for their apparently similar positions. The evidence gathered suggested that there may be a subtle, but important, connection between the mathematical epistemology a teacher holds and their ability to admit beliefs about the role of language in learning mathematics beyond merely acting as a conduit for information. If this is indeed the case, then efforts to train mathematics teachers about language use in their classrooms must necessarily take into account those teachers' mathematical epistemologies.

Recommendations

Given the findings outlined in this study, it bears considering how such insights might be used to improve teacher development practice. Drawing on Freeman (1991) and Chapman (2002), I suggest that once the beliefs of teachers are better understood, the next steps might include:

1. The *explication* of these beliefs in a manner that allows teachers to develop awareness of their own beliefs (Freeman, 1991)
2. Supporting teachers to notice the conflicts or challenges their beliefs bring about in their own classrooms, and
3. Assisting them to address these instead of ignoring them (Chapman, 2002).

Teacher development programmes that are structured around this process may well have some success in effecting meaningful change, for example (Chapman, 2002) but as in that study, due consideration of each teacher's individuality must be given, along with the social constraints within which they operate.

Programmes that seek to bring about stable and persisting change in this manner would necessarily require in-school support for teachers: short workshops have been shown to not effect change in practice (Graven, 1997). These programmes would also need to be mindful of teachers' self-beliefs and identity, particularly in relation to their confidence (Graven, 2004) and self efficacy (Wenner, 2001), appreciating the interconnectedness of beliefs, as well as their centrality (Chapman, 2002).

Conclusion

These recommendations leave many unanswered questions. Further research needs to be conducted into how to explicate beliefs to their holders, how to tailor constructive cognitive conflict to each teacher, as well as how to support teachers through potentially difficult change. Should such research reveal beliefs to be a productive source of praxis in teacher development, limitations of resources for such programmes still pose a daunting challenge for such programmes. Some may ask whether such intense teacher development programmes are affordable. If addressing beliefs proves effective, the alternative question is: can we afford not to?

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Addenda

Addendum A: Initial Interview Questions.

The following apparatus was used to guide questioning through the initial interview for each teacher.

General information:

1. Name:
2. Date of birth:
3. Place of birth:

Linguistic Profile

I started this section by asking each participant to complete a graphic linguistic profile (Busch, 2010) as a means of exploring their linguistic heritage and reported proficiency. See Addendum B for the results of this.

1. First language of mother:
2. First language of father:
3. Language at home during childhood:
4. List languages spoken and self-rated proficiency in each (spoken and written).
5. What language(s) do you speak at home now?
6. Do you read in all these languages? If not, why?
7. What languages do you wish to learn? Why these?

General education history

1. Date of matriculation:
2. School attended:
3. Any further formal education and training since school (other than teacher qualifications):

History of Teacher Training

1. When did you become a teacher?
2. Where did you train?
3. What type of course did you do? How long was it?
4. Was the course more theory focused or did you have the opportunity to train in a school?

History of Mathematics Education

1. How would you rate your own performance of mathematics at school?
2. Have you ever had the opportunity to learn more mathematics beyond school level?
3. Did you receive any additional training in mathematics when you trained to become a maths teacher over and above what you learned at school?
4. What language did you learn maths in at school?
5. Describe your own experience of learning mathematics at school…
6. Do you feel you've been given enough training and knowledge in mathematics to teach it well?

Beliefs

Language Beliefs

1. Do you think all languages are equal? Why/why not?
2. Do you think there are 'right' and 'wrong' ways to use a language? Can you give an example?
3. What do you think about languages in South Africa?

Beliefs about learning through an addition language

1. What language(s) do you think children at school should use for their learning in all their subjects? Why?
2. What problems do you encounter when trying to use Xhosa or English in the classroom
3. Do you think that some languages are naturally better for learning than others? Why?
4. What language(s) do you think should be used specifically in the maths classroom? Why?

Beliefs about mathematics

1. What do you think a student needs to be able to do to say they 'know' mathematics?

At this point, some discussion structured around a selected question from the textbook that the school uses will be conducted to ask a teacher what is 'difficult' or 'easy' about a particular idea in mathematics.

Beliefs about learning mathematics

1. What should a student do to succeed in maths class?
2. What is the best way to ensure maximum understanding when teaching maths?

Again, another discussion around a different source from the school textbook will be pursued here to explore the ways a teacher 'might' approach a certain topic, or identify anticipated difficulties.

Beliefs about mathematics and language

1. Do you think words about mathematics are difficult to learn for your students? Why?
2. Do you think knowing these words is important to being able to learn mathematics? Why?
3. Do you think speaking about mathematics is different to speaking about other subjects? Why?
4. Is there anything about how mathematics questions in exams are structured which you think makes understanding them difficult?

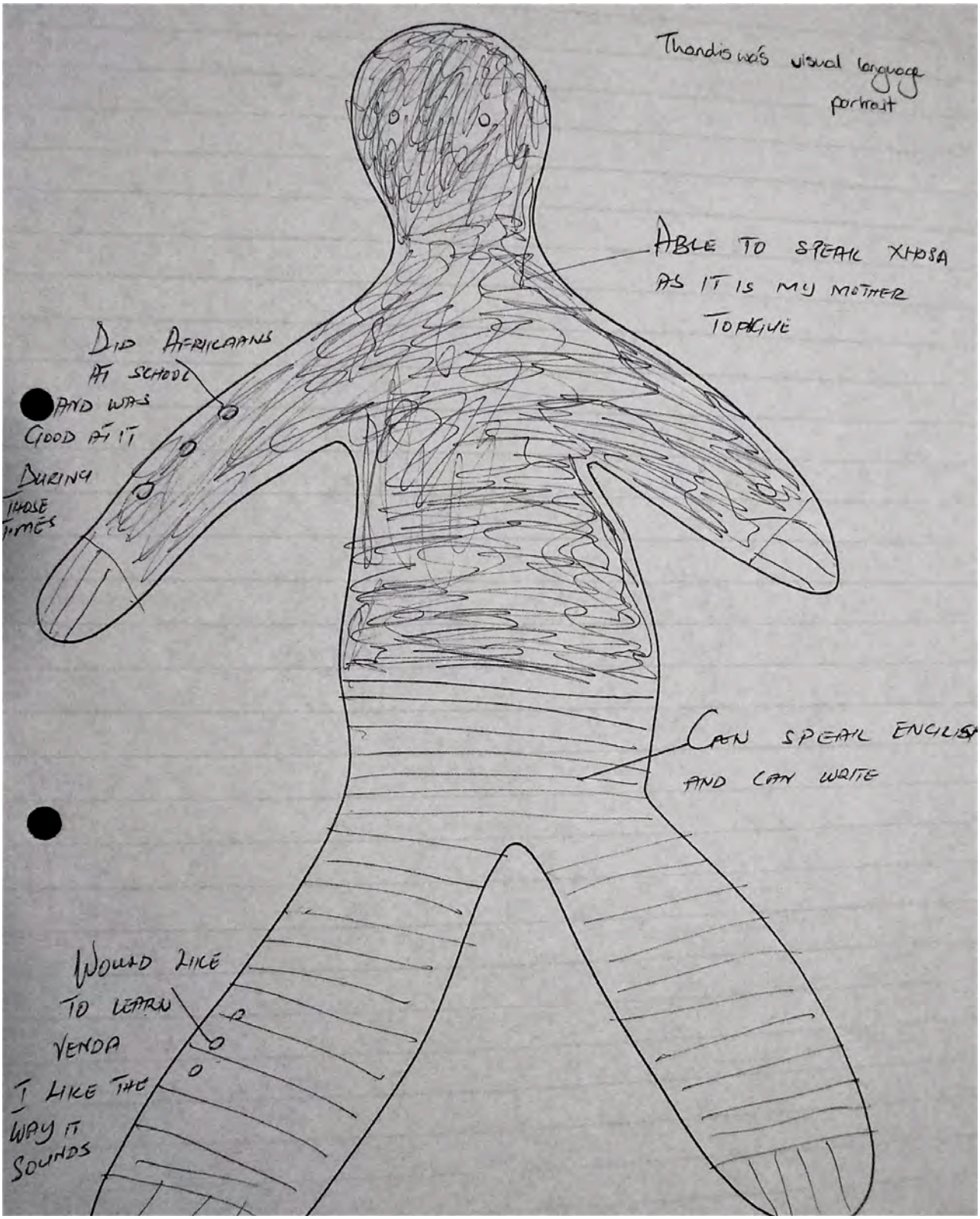
Beliefs about learning mathematics through a second language

1. Do your students struggle learning mathematics through English more than you think they struggle in other subjects? Why?
2. Do you think learning English is fundamental to understanding mathematics? Why?
3. What causes trouble for learners when they try to discuss their maths learning in the classroom?
4. Do you think some languages are better suited for teaching and learning mathematics than others? Why?

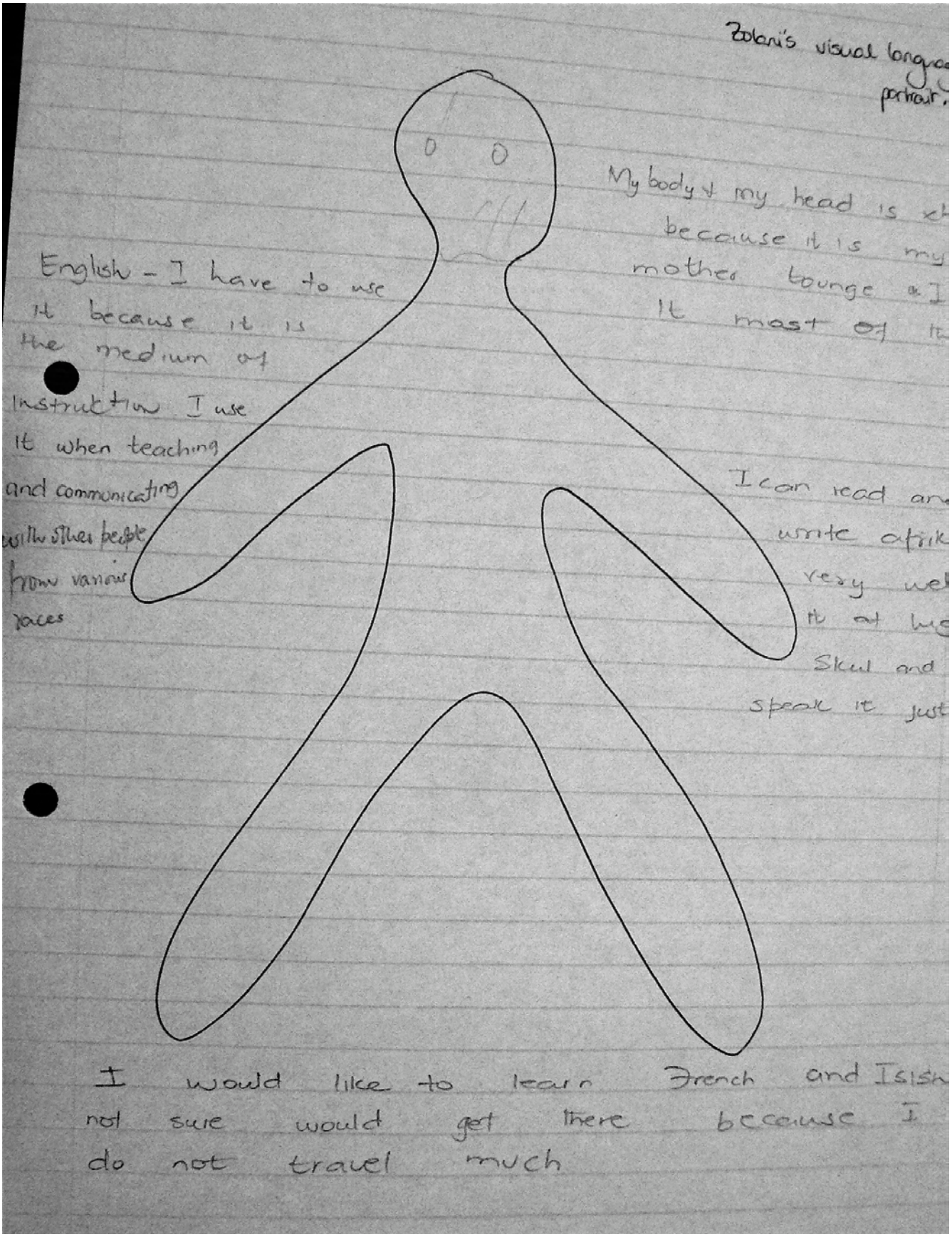
Of course these questions have the usual caveat that they are merely anticipated discussion prompts: topics that arise during the course of the interview will be explored as they are discovered.

Addendum B: Teacher Language Portraits

Thandiswa



Zolani


Zolani's visual langua
portrait.
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it most of th
English - I have to use
it because it is
the medium of
instruction I use
it when teaching
and communicating
with other people
from various
races
I can read an
write afrik
very wel
it at hig
Skul and
speak it just
I would like to learn French and Isish
not sure would get there because I
do not travel much

Addendum C: Student information-gathering apparatus (English and Xhosa)

The following questionnaire was issued to all grade 8, 9 and 10 students at Biko Secondary. Students had the option of selecting to complete this questionnaire in either English or Xhosa.

English

General details

Name of your maths teacher:		Age:		Grade*:*	

Family

Who do you live with? Please list everyone in your home, by saying how they are related to you. Please do not give their names. For example, you can write "Mother, 40" or "Uncle, 62".

Relation to you	Age

Do any of your family *not* live with you? Please write where they live. Again, please do not give names. Example: Brother, 22, Cape Town

Relation to you	Age	Where they live

Who helps to buy the food and pay the bills at home? Please don't give their names, but say how they are related to you (or say 'friend' if they are not), and what they do for work. If they receive a government grant, please write 'grant' as their job.

Relation to you	Type of work they do

Mathematics

What mark did you get for mathematics last year at school?		%
Do you like mathematics as a subject? Circle your answer.	yes	no
Why? Please explain your answer.		
Do you think mathematics is important? Circle your answer.	yes	No
Why? Please explain your answer.		
What do you do to study for a maths test?		

Languages

Which language(s) can you **speak**? Please tick one answer only for each of the following languages.

isiXhosa	Not at all	A little bit	Quite well	Fluent
isiZulu	Not at all	A little bit	Quite well	Fluent
isiNdebele	Not at all	A little bit	Quite well	Fluent
Siswati	Not at all	A little bit	Quite well	Fluent
Sepedi	Not at all	A little bit	Quite well	Fluent
Setswana	Not at all	A little bit	Quite well	Fluent
Sesotho	Not at all	A little bit	Quite well	Fluent
Xitsonga	Not at all	A little bit	Quite well	Fluent
Tshivenda	Not at all	A little bit	Quite well	Fluent
English	Not at all	A little bit	Quite well	Fluent
Afrikaans	Not at all	A little bit	Quite well	Fluent
Other	Not at all	A little bit	Quite well	Fluent

If you circled “other”, please write which other languages you can speak here:

_____

Which language(s) can you **read and write*?*** Please tick one answer only for each of the following:

isiXhosa	Not at all	A little bit	Quite well	Fluent
isiZulu	Not at all	A little bit	Quite well	Fluent
isiNdebele	Not at all	A little bit	Quite well	Fluent
Siswati	Not at all	A little bit	Quite well	Fluent
Sepedi	Not at all	A little bit	Quite well	Fluent
Setswana	Not at all	A little bit	Quite well	Fluent
Sesotho	Not at all	A little bit	Quite well	Fluent
Xitsonga	Not at all	A little bit	Quite well	Fluent
Tshivenda	Not at all	A little bit	Quite well	Fluent
English	Not at all	A little bit	Quite well	Fluent
Afrikaans	Not at all	A little bit	Quite well	Fluent
Other	Not at all	A little bit	Quite well	Fluent

Other: _____

IsiXhosa

Iinkcukacha

Igama likatitshala(kazi) wakho wezibalo:		Ubudala:		Ibanga:	

Usapho lwakho

Uhlala nabani? Khawubhale ezantsi bonke abantu abahlala kokwenu, usixelela ukuba nizalana kanjani. Sicela ungasiniki amagama abo. Umzekelo, ungabhala “Umama, 40” okanye “Umalume, 62.”

Indlela abazalana nawe ngayo	Ubudala

Ukhona umntu wakokwenu ozalana nawe ongahlali nawe? Khawubhale indawo abahlala kuyo. Kwakhona, sicela ungasiniki amagama abo. Umzekelo: “uDadowethu, 25, eKapa”.

Indlela abazalana nawe ngayo	Ubudala	Indawo abahlala kuyo.

Ngubani othenga ukutya nobhatala ii-akhawunti zasekhaya? Sicela unganiki amagama abo, utsho indlela abazalana nawe ngayo (okanye ukuba abazalani nawe, khawubhale ‘umhlobo’), ubhale umsebenzi wabo. Ukuba bafumana isixhaso semali kuRhulumente, khawubhale ‘i-grant’ phantsi kwesihloko esithi ‘Umsebenzi wabo’.

Indlela abazalana nawe ngayo	Umsebenzi wabo

Izibalo

Ufumene eliphi inqaku kwizibalo kulo nyaka ophelileyo esikolweni?	%	
Uyazithanda izibalo? Khawukhethe 'ewe' okanye 'hayi'.	ewe	hayi
Kutheni usitsho? Khawucacise impendulo yakho.		
Ucinga izibalo zibalulekile? Khawukhethe 'ewe' okanye 'hayi'.	ewe	hayi
Kutheni usitsho? Khawucacise impendulo yakho.		
Wenza ntoni ukufundela uvavanyo lwezibalo?		

Iilwimi

Zeziphi iilwimi okwazi ukuzi**thetha**? Khawutikishe impendulo ibe nye kulwimi ngalunye .

isiXhosa	Andisazi tu!	Kancinci	Kakuhle	Ngokupheleleyo
isiZulu	Andisazi tu!	Kancinci	Kakuhle	Ngokupheleleyo
isiNdebele	Andisazi tu!	Kancinci	Kakuhle	Ngokupheleleyo
isiSwati	Andisazi tu!	Kancinci	Kakuhle	Ngokupheleleyo
isiPedi	Andisazi tu!	Kancinci	Kakuhle	Ngokupheleleyo
isiTswana	Andisazi tu!	Kancinci	Kakuhle	Ngokupheleleyo
isiSuthu	Andisazi tu!	Kancinci	Kakuhle	Ngokupheleleyo
isiTsonga	Andisazi tu!	Kancinci	Kakuhle	Ngokupheleleyo
isiVenda	Andisazi tu!	Kancinci	Kakuhle	Ngokupheleleyo
isiNgesi	Andisazi tu!	Kancinci	Kakuhle	Ngokupheleleyo
isiBhulu/i-Afrikaans	Andisazi tu!	Kancinci	Kakuhle	Ngokupheleleyo
Ezinye	Andisazi tu!	Kancinci	Kakuhle	Ngokupheleleyo

Ukuba ukhethe "Ezinye", khawuzibhale phantsi iilwimi okwazi ukuzithetha: _____

Zeziphi iilwimi okwazi ukuzi**bhala** nokuzi**funda**? Khawutikishe impendulo ibe nye kulwimi ngalunye ..

isiXhosa	Andisazi tu!	Kancinci	Kakuhle	Ngokupheleleyo
isiZulu	Andisazi tu!	Kancinci	Kakuhle	Ngokupheleleyo
isiNdebele	Andisazi tu!	Kancinci	Kakuhle	Ngokupheleleyo
isiSwati	Andisazi tu!	Kancinci	Kakuhle	Ngokupheleleyo
isiPedi	Andisazi tu!	Kancinci	Kakuhle	Ngokupheleleyo
isiTswana	Andisazi tu!	Kancinci	Kakuhle	Ngokupheleleyo
isiSuthu	Andisazi tu!	Kancinci	Kakuhle	Ngokupheleleyo
isiTsonga	Andisazi tu!	Kancinci	Kakuhle	Ngokupheleleyo
isiVenda	Andisazi tu!	Kancinci	Kakuhle	Ngokupheleleyo
isiNgesi	Andisazi tu!	Kancinci	Kakuhle	Ngokupheleleyo
isiBhulu/i-Afrikaans	Andisazi tu!	Kancinci	Kakuhle	Ngokupheleleyo
Ezinye	Andisazi tu!	Kancinci	Kakuhle	Ngokupheleleyo

Ezinye: _____

Addendum D: Stimulated recall interview questions: Zolani

Question #	Priority	Type	Observation #	Time on observation video	Question	Themes
34	6	gen	F	--	what did I miss in Friday's lesson? (18th May 2012)	admin
36	5	clip	F	28:20,0	*panning across groups of students--aide memoir on different groups in class. Ask Zolani to share her knowledge about the students in detail.*	students
42	5	clip	F	41:30,0	The students seem much more likely to ask you questions during classwork time--why do you think this is the case?	formative assessment
3	5	gen	2	44:00,0	Xhosa dictionary (Cambridge)--look at different definitions of 'opposite'. Also 'triangle' and 'perpendicular'. What do you think of these explanations? Would you use them in your classroom? Are there reasons to *not* use them in the classroom?	dictionary
7	5	gen	Int, 2, 2	30:40,0; 39:05,0; 41:20,0	I have seen a *lot* of dependency on calculators, which you mentioned before in the II, both in your class and in Grade 9. It seems they are so dependent that if they don't have them, they can't work!! What could be done to wean them off calculators?	calculators
8	5	gen	1		There seems to be a lot of memorization required: trig ratios, Pythagoras… does being a good mathematician require a good memory?	

11	5	gen	1	10:50,0	when looking for responses from students, what is best? A) just let them answer, singularly or together, B) ask for students by name C) ask them to put up hands?	
12	5	gen	NB	--	firstly, how representative do you think these lessons are of what happens normally in your classroom? For you? For the students?	validity
15	5	gen	NB	--	Are there, to your knowledge, any students in your class who have special education needs?	students
19	5	gen	NB	--	there are a few older students in the class--what impact does this have?	students
22	5	gen	NB	--	Which students in your class are succeeding? How do you know? Tests? Classwork?	students
23	5	gen	NB	--	Which students in your class are *really* struggling? How do you know? Tests? Classwork?	students
25	5	gen	NB	--	Do the students choose where they sit or did you arrange the seating?	classroom
26	5	gen	NB	--	Do you think the students behaved differently in front of the camera? Was I a distraction for them?	behaviour man
33	5	gen	F	01:32,0	Do you ever give out punishment when homework is not done? What kinds of penalties might you give?	
13	4	clip	1,2	14:00,0; 44:00,0	the students seemed to find the word 'opposite' quite confusing… the hypotenuse is 'opposite' the right-angle, yet, the other sides can be 'opposite' too… and what they are depends on which angle they are working with! Then the word 'opposite' came up with regard to reciprocals...	dictionary
17	4	clip	1	37:43,0	The students were, in the first observation, very quiet, in contrast with some of the other classwork sessions. Why do you think this was the case?	

18	4	clip	1	35:00,0	During classwork, you are usually moving around the room from table to table. What does this enable you to do? Control behaviour? Detect errors in the students' work? Affirm that the students are on the right track?	classwork
29	4	clip	2	17:40,0	"At least they have an idea!"… until [18:35]. Students trying to remember prior learning… how do you think it affects the students when you take their offerings like this and build on it?	formative assessment
40	4	clip	F	38:44,0	There was definitely an issue around the concept of the lowest common denominator in the last lesson--how many students do you think were struggling with their adding and subtracting of fractions? Why do you think this is the case?	
2	4	gen	Int	--	you said in your initial interview that CS doesn't occur so much in maths class as half the words (mostly the maths terms) don't exist in Xhosa anyway. Can they be *explained* in Xhosa? For example, you used the word 'phesheya' to explain the 'opposite side of a triangle in one of your lessons...	dictionary
6	4	gen	Int		ubix cube: in the II, you mentioned that the first thing a student should have is passon for mathematics. Sometimes, something like this <cube> can hook a learner into problem-solving and puzzles. Would you ever try something like that in class to try and spark their interest? Do you think it might work?	
16	4	gen	1	36:05,0	what is the role of *visualising* in mathematics? Can all mathematics be represented visually? Do you think learners respond to graphic representations? How so?	
20	4	gen	NB	--	by your estimate, what percentage of students have calculators?	calculators
21	4	gen	1; 2	41:17,0; 13:30,0	Students work at different rates--what if students had an answer sheet to mark their own work and then ask questions of each other and you when they go wrong? Would this work? Pros/cons?	classwork

27	4	gen	2	--	did you notice that with each subsequent observation, you spoke more and more Xhosa? Unfortunately I haven't transcribed every lesson as it takes a long time. Was this deliberate? Or did you feel a bit self-aware initially and eventually settle in and become more comfortable?	language use
32	4	gen	3	--	how much copying of work do you think occurs? Do the students distinguish between *mastery* of the topic and just having the right answer in their books? Why do you think a student might copy?	
35	4	gen	F	17:30,0	you often offer the students opportunities to ask questions--why do you think they don't take up your offer?	formative assessment
37	4	gen	NB	--	Is the classroom deliberately arranged into groups? Would you ever arrange the desks into rows?	classroom
24	3	clip	1	45:39,0	The girls (back-left) had their calculators on something other than DEG. Did you ever get to explore radians or other forms of measuring angles during the maths component of your teacher training?	training
39	3	clip	F	27:54,0	When you've had to pop out briefly (which always happens now and then), the students are very good and keep working in your absence? Is this the norm?	behaviour man
41	3	clip	F	39:50,0	The student who did her homework: does she usually do well? What does she do that the others don't? (apart from homework, that is!)	
10	3	gen	1	08:50,0	great quote from the lesson "you look at what you are given, and then you have to know the relationship between the two!" This struck me as quite a profound description of mathematics generally--do you think it is an accurate description?	
30	3	gen	3	01:00,0	Is it always best to start a lesson with revision of the previous learning?	lesson structure

31	3	gen	3	11:10,0	you often write a whole question out on the board: is this due to resource constraints or is it a good way to model the language of maths questions? Conversely, do you find it uses up a lot of your class time?	language use
38	3	gen	F	--	What do the books of the students show you?	formative assessment
1	2	gen	Int	--	There was a period in Cata when poverty increased significantly… having been working at Geju for so long, do you think that the decrease in diligence you have witnessed could be related to this? If so, what as a teacher do you feel you can do to influence this?	
4	2	gen	Int	18:55,0	you mentioned in your initial interview that some topics require more language modelling than others--to be 'deep in code-switching'… would you classify trignometry as one of these topics? Why? What other topics could you think of that fall into this category? Can you think of any that don't?	
5	2	gen	Int	24:50,0	I say 'solving 4b..'--> Zol: 'solving for b…'… this is a classic case of ambiguity that came up in our initial interview where my 'four' was interpreted by you as 'for' and not incorrectly either! Do instances like this require careful planning around examples that might confuse the students?	
28	2	gen	2	--	you use your voice with great variety… were you trained at teaching college on how to use your voice effectively?	training

Addendum E: Stimulated recall interview questions: Thandiswa

Question #	Priority	Type	Observation #	Time	Question	Themes
34	6	gen	F	--	what did I miss in Friday's lesson? (18th)	admin
36	5	clip	F	28:20,0	*panning across groups of students--aide memoir on different groups in class.*	students
42	5	clip	F	41:30,0	The students seem much more likely to ask you questions during classwork time--why do you think this is the case?	formative assessment
3	5	gen	2	44:00,0	Xhosa dictionary (Cambridge)--look at different definitions of 'opposite'. Also 'triangle' and 'perpendicular'. What do you think of these explanations? Would you use them in your classroom? Are there reasons to *not* use them in the classroom?	dictionary
7	5	gen	ii, 2, 2	30:40,0; 39:05,0; 41:20,0	I have seen a *lot* of dependency on calculators, which you mentioned before in the II, both in your class and in Grade 9. It seems they are so dependent that if they don't have them, they can't work!! What could be done to wean them off calculators?	calculators
8	5	gen	1		There seems to be a lot of memorization required: trig ratios, Pythagoras… does being a good mathematician require a good memory?	
9	5	gen	1		The ratio of girls to boys in the class is quite heavily skewed towards the girls. Do you think there is a difference between the genders in terms of 1) talent? 2) performance? 3) diligence?	
11	5	gen	1	10:50,0	when looking for responses from students, what is best? A) just let them answer, singularly or together, B) ask for students by name C) ask them to put up hands?	
12	5	gen	NB	--	firstly, how representative do you think these lessons are of what happens normally in your classroom? For you? For the students?	validity
15	5	gen	NB	--	Are there, to your knowledge, any students in your class who have special education needs?	students

19	5	gen	NB	--	there are a few older students in the class--what impact does this have?	students
22	5	gen	NB	--	Which students in your class are succeeding? How do you know? Tests? Classwork?	students
23	5	gen	NB	--	Which students in your class are *really* struggling? How do you know? Tests? Classwork?	students
25	5	gen	NB	--	Do the students choose where they sit or did you arrange the seating?	classroom
26	5	gen	NB	--	Do you think the students behaved differently in front of the camera? Was I a distraction for them?	behaviour man
33	5	gen	F	01:32,0	Do you ever give out punishment when homework is not done? What kinds of penalties might you give?	
13	4	clip	1,2	14:00,0; 44:00,0	the students seemed to find the word 'opposite' quite confusing… the hypotenuse is 'opposite' the right-angle, yet, the other sides can be 'opposite' too… and what they are depends on which angle they are working with! Then the word 'opposite' came up w.r.t reciprocals…	dictionary
17	4	clip	1	37:43,0	The students were, in the first observation, very quiet--> in contrast with some of the other classwork sessions. Why do you think this was the case?	
18	4	clip	1	35:00,0	During classwork, you are usually moving around the room from table to table. What does this enable you to do? Control behaviour? Detect errors in the students' work? Affirm that the students are on the right track?	classwork
29	4	clip	2	17:40,0	"At least they have an idea!"… until [18:35]. Students trying to remember prior learning… how do you think it affects the students when you take their offerings like this and build on it?	formative assessment
40	4	clip	F	38:44,0	There was definitely an issue around the concept of the lowest common denominator in the last lesson--how many students do you think were struggling with their adding and subtracting of fractions? Why do you think this is the case?	
2	4	gen	ii	--	you said in your initial interview that CS doesn't occur so much in maths class as half the words (mostly the maths terms) don't exist in Xhosa anyway. Can they be *explained* in Xhosa? For example, you used the word 'phesheya' to explain the 'opposite side of a triangle in one of your lessons…	dictionary
6	4	gen	ii		rubix cube: in the II, you mentioned that the first thing a student should have is passon for mathematics. Sometimes, something like this <cube> can hook a learner into problem-solving and puzzles. Would you ever try something like that in class to try and spark their interest? Do you think it might work?	

16	4	gen	1	36:05,0	what is the role of *visualising* in mathematics? Can all mathematics be represented visually? Do you think learners respond to graphic representations? How so?	
20	4	gen	NB	--	by your estimate, what percentage of students have calculators?	calculators
21	4	gen	1; 2	41:17,0; 13:30,0	Students work at different rates--what if students had an answer sheet to mark their own work and then ask questions of each other and you when they go wrong? Would this work? Pros/cons?	classwork
27	4	gen	2	--	did you notice that with each subsequent observation, you spoke more and more Xhosa? Unfortunately I haven't transcribed every lesson as it takes a long time. Was this deliberate? Or did you feel a bit self-aware initially and eventually settle in and become more comfortable?	language use
32	4	gen	3	--	how much copying of work do you think occurs? Do the students distinguish between *mastery* of the topic and just having the right answer in their books? Why do you think a student might copy?	
35	4	gen	F	17:30,0	you often offer the students opportunities to ask questions--why do you think they don't take up your offer?	formative assessment
37	4	gen	NB	--	Is the classroom deliberately arranged into groups? Would you ever arrange the desks into rows?	classroom
24	3	clip	1	45:39,0	The girls (back-left) had their calculators on something other than DEG. Did you ever get to explore radians or other forms of measuring angles during the maths component of your teacher training?	training
39	3	clip	F	27:54,0	When you've had to pop out briefly (which always happens now and then), the students are very good and keep working in your absence? Is this the norm?	behaviour man
41	3	clip	F	39:50,0	The student who did her homework: does she usually do well? What does she do that the others don't? (apart from homework, that is!)	
10	3	gen	1	08:50,0	great quote from the lesson "you look at what you are given, and then you have to know the relationship between the two!" This struck me as quite a profound description of mathematics generally--do you think it is an accurate description?	
30	3	gen	3	01:00,0	Is it always best to start a lesson with revision of the previous learning?	lesson structure
31	3	gen	3	11:10,0	you often write a whole question out on the board: is this due to resource constraints or is it a good way to model the language of maths questions? Conversely, do you find it uses up a lot of your class time?	language use

38	3	gen	F	--	What do the books of the students show you?	formative assessment
1	2	gen	ii	--	There was a period in Cata when poverty increased significantly… having been working at Geju for so long, do you think that the decrease in diligence you have witnessed could be related to this? If so, what as a teacher do you feel you can do to influence this?	
4	2	gen	ii	18:55,0	you mentioned in your initial interview that some topics require more language modelling than others--to be 'deep in code-switching'… would you classify trignometry as one of these topics? Why? What other topics could you think of that fall into this category? Can you think of any that don't?	
5	2	gen	ii	24:50,0	I say 'solving 4b..'--> Zol: 'solving for b…'… this is a classic case of ambiguity that came up in our initial interview where my 'four' was interpreted by you as 'for' and not incorrectly either! Do instances like this require careful planning around examples that might confuse the students?	
28	2	gen	2	--	you use your voice with great variety… were you trained at teaching college on how to use your voice effectively?	training

Addendum F: Likert scale used in stimulated recall interviews

During the initial analysis of the classroom observation data, some commonalities be
From these, the following Likert scale was constructed and issued as part of the final
interview.

Please read the following statements carefully and tick the box that best fits your op

	Statement	Strongly disagree	Disagree	Ag
1	Students should use dictionaries in class to help them with their work.			
2	As a teacher, I feel I have a strong influence on the lives of my students.			
3	Some students just won't ever really understand maths.			
4	Students learn more when taught by the teacher than when taught by each other.			
5	The burden on English teachers is greater than other teachers because they provide students with the language they need in their other classes.			
6	Talking about mathematics (in any language) is no different to talking about other subjects at school.			
7	There is usually only one way to solve a particular type of maths problem.			
8	Students don't really need to learn any maths outside of the school curriculum.			
9	A student can use a language for learning without being able to speak it.			
10	Learner-centred approaches (like OBE) work well for teaching mathematics.			

Addendum G: Transcription conventions

Standard size: 12pt

Font face: Calibri

Indicating the speaker(s):

Zol/Tha:	Zolani/Thandiswa speaking
SS:	Many students speaking (in chorus)
S-(letter):	Single student speaking

Overlap

Utterances bracketed with a long vertical square bracket and aligned vertically signify overlap.

Sequential utterances are separated by 6pt paragraph spacing. Concurrent utterances have 0pt paragraph spacing in between them.

Example of sequential utterances:

Tha: What do we call this type of expression?

S1: A monomial.

Example of concurrent utterances:

Tha: What do we call this type of expression? A monomial.
SS: monomial.

…where the brackets and closer line spacing indicate concurrent utterances and which words are said simultaneously.

Indicating the tone and pace:

Wording in 14pt:	Speech that is distinctly louder
Wording in 10pt:	Speech that is distinctly softer
...	Short pause (less than 5 seconds)
/ /	Longer pause (more than 5 seconds). The number between slashes indicates the length of the pause in seconds e.g. / 7 / indicates a pause of seven seconds

Indicating the language used:

Wording underlined:	Speech in Xhosa
(wording between round brackets)	translation of Xhosa into English.

Researcher's mark-up:

notes\	bold text between backslashes show extra information

Non-verbal:

Right-column italicized	descriptions of teacher actions, including board writing.

Addendum H: Ethics forms

The ethics forms used for this study are detailed below, in Xhosa and in English

Isicelo Semvume sokuthatha Inxanxheba Eluphandweni

Igama Lophando: Iinkolo zootitshala malunga nendlela abafundisa ngayo xa besebensiza ulwimi ekufundiseni izibalo kwisikolo esiselalini.

Umntu ophandayo: Nks. Sara Muller

Isebe: Isikolo Semfundo
Graduate Humanities Building
Upper Campus
University of Cape Town
Private Bag X5
Rondebosch 7700

Ifowunamba: +27 (0) 71 769 8435

I-imayili: noxolo.muller@gmail.com OKANYE blksar001@uct.ac.za

Mhlekazi obekekileyo

Ndiyathemba uphilile. Ndiyakubhalela kuba ndifuna ukukunika inkcazelo malunga nophando lwam oluza kwenzeka e*Makhaya* ngoCanzibe neyeSilimela (ngoEpreli nangoMeyi) kulo nyaka, 2012, e*Biko* Secondary School.

Olu phando lungantoni?

Injongo yophando lwam kukuqonda umsebenzi wootitshala abakwisikolo sase*Makhaya* xa befundisa izifundo zezibalo. Ndifuna nokuyiqonda indlela abafundisa abafundi izibalo ngayo, nezinto abazisebenzisa ukugqiba imisebenzi yabo. Ndifuna ingakumbi ukuqonda bajongana njani neengxaki zesiNgesi nesiXhosa— iingxaki eziquka iincwadi zesikolo neevavanyo ezibhaliwe ngesiNgesi kodwa ulwimi olusetyenziswa ngabafundi ekhaya sisiXhosa.

Ngokuhamba kwexesha, ndicela ukubukela nokukurhekoda nge-camera xa ufundisa (ingaba izifundo ezinthathu okanye ezine). Ndizokubuza imibuzo ngawe nangomsebenzi wakho njengotitshala. Ndifuna nokwazi izimvo zakho malunga nokufundisa izibalo ngendlela efanelekileyo . Andizi kukuhlola: ayikho indlela efanelekileyo okanye engafanalekanga: ndifuna ukuva nje iingcinga zakho nendlela ojongana neengxaki ngayo

Ndiza kucela wenze ntoni?

Okokuqala, ndizocela ndibe nodliwano-ndlebe nawe phambi kokuba ndikubone eklasini yakho. Emva koko ndizocela ukubukela ezinye izifundo zakho, ngexesha elikufaneleyo: ndizozirhekordisha ezi zifundo nge-camera. Ngelinye ixesha, ndizokucela ulungiselele uze ufundise isifundo ocinga ukuba sibonisa

eyona ndlela intle ukufundisa izibalo, ngakumbi eyona ndlela intle ukusebenzisa ulwimi namagama okuzifundisa. Sizodibana kwakhona emva kwesi sifundo, size sincokole sixoxe ngendlela ozoyisa ngayo iingxaki ngayo eklasini yakho. Sizosebenzisa iividiyo ukuzikhumbuza.

Ukuba wonwabile kwaye unika imvume yakho yokuthatha inxanxheba kolu phando, ndicela uzalise eli phetshana lemvume ulibuyise kum. Ukwakhululekile **ukuba** uyeke kolu phando. Iinkcazelo ngawe azizi kusetyenziswa ukuba wenza njalo.

Alikho ixabiso lokuthatha inxanxheba. Andikholelwa uzozifaka engozeni ukuba uthatha inxanxheba: ngokwenene ndiyathemba uza kuncedwa lulo.

Khawufunde uphawule zonke izinto ezilandelayo (ungakhethi uA noB: khawuphawule omnye wodwa), ubhale igama lakho phantsi kwale ncwadi.

Khawuphawule:

Uyavuma ukuthatha inxanxheba eluphandweni olu.		
Ndiyifundile le ncwadi kakuhle, bendinethuba elaneleyo lokubuza imibuzo ngolu phando.		
Ndiyavuma ukuba iimpendulo zam zizosetyenziselwa imfundo nophando, phantsi kumgaqo-nkqubo wemifihlelo olandelayo: (khawuphawule uA okanye uB wodwa!):		
A	Ayikho ingxaki ukuba ufuna ukusebenzisa iinkcazelo zam (igama lam, njalo njalo) kolu phando.	
B	Ndikhetha iinkcazelo zam mazingasetyenziswa eluphandweni: ndicela igama lam lingasetyenziswa, kusetyenziswe igama elingelolam ukuze ndingaziwa	
Ndiyaqonda ukuba andinyanzeliswa ukuthatha inxanxheba kolu phando.		
Ndiyaqonda ukuba ndingayeka kolu phando nanini na.		

Igama lakho: _____

Uphawu lwakho: _____ Umhla: _____

Igama lomntu ophandayo: Sara Muller

Uphawu lomntu ophandayo: _____ Umhla: _____

Request for Consent to Participate in Research

Project Title: Teachers' beliefs about using language to teach mathematics in a rural Xhosa secondary school.

Researcher: Ms. Sara Muller

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Dear Sir/Madam

I hope this letter finds you well. I am writing to you to provide you with some information about a study I will be conducting the village of *Makhaya* during April and May of this year, 2012, based at *Biko* Secondary School.

What is the study about?

The purpose of my research is to acquire a better understanding of how the teachers at *Biko* Secondary go about their work in mathematics lessons, how they present the material to the students and how they draw upon the resources available to them to complete their task, particularly as they negotiate the difficulties around English and Xhosa, with the exam and textbooks being in English and the students speaking Xhosa at home.

During the study, I would like to watch and record some of your lessons, as well as ask you about yourself, your career as a teacher and your thoughts and feelings about what constitutes good maths teaching. The research is not in any way meant to make you feel as if your performance is being assessed: there is no 'right' or 'wrong'. I merely wish to understand what you think about teaching and how you go about navigating the challenges in your work.

What will I need you to do?

Initially, I would like to interview you before I come and see you in your classroom. After that I would like to watch some of your lessons, which we can arrange around times convenient for you: these lessons will be recorded on a video camera. I will ask you at some point to prepare and deliver a lesson which you feel shows what you think is the best way to teach, focusing on how language is used in the lesson. Afterwards, we will have another interview during which we can watch the videos together to talk about how you solve challenges in your classroom.

If you are happy to participate in this study, please complete this form and return it to me. **You are free, at any time, to withdraw your consent** should you feel you no longer wish to participate in the study, and any information about yourself will **not** be used in the research if you do so.

It should also be noted that **there are no costs involved in this study for your part**. I do not believe there are any risks to your person of any nature, and hope that you will find the reflection during the interview process interesting and useful.

Please tick all the following and then sign at the bottom of this letter.

		Please tick
I agree to participate in this research project.		
I have read this consent form and the information it contains and I have had the opportunity to ask any questions about the study.		
I agree to my responses being used for education and research on condition my privacy is respected, subject to the following **(please tick only A or B, not both!):**		
A	I understand that my personal details may be included in the research	
B	I understand that my personal details will not be included and I will be referred to by an alias or as a member of a group so that I will not be identifiable.	
I understand that I am under no obligation to take part in this study.		
I understand that I have the right to withdraw from this study at any stage.		

Name of Participant: _____

Signature of Participant: _____ Date: _____

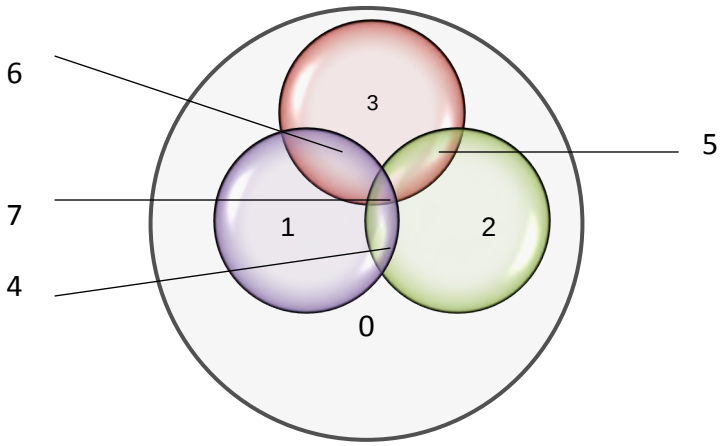
Name of Researcher: Sara Muller

Signature of Researcher: _____ Date: _____

Addendum I: Thandiswa's beliefs and Addendum J: Zolani's beliefs

In Addendum I and J, I list the beliefs of each teacher as they were coded against their interviews. Each belief is given a numerical code based on the area of the Beliefs Area Map that it falls into. These codes are listed below for reference.

Area on Beliefs Area Map	**Code**	**Description**
Context	0	Any beliefs that have to do with the nature of society, certain types of people or specificities of particular situations like *this* school, *these* students or *this* community i.e. beliefs that are not held as a general rule but rather about a specific instantiation
Teaching and learning	1	Beliefs that pertain to teaching and learning in general, independent of language or subject
Language	2	Beliefs that pertain to language as an entity, in society in general and not just in the school
Mathematics	3	Beliefs that pertain to the nature of mathematics as a discipline, not just within school
Teaching and learning of, and through, language	4	How language is acquired and used as a medium of learning and teaching
Language and mathematics	5	The nature of language as it relates to mathematics as a discipline
Teaching and learning of mathematics	6	Beliefs about how best (or worst) to go about teaching and learning mathematics. Includes affect around maths, gender and maths, maths-learning-potential and maths-learning-ability etc.
Teaching and learning of mathematics as, and through, language	7	Any beliefs that touch on the nature of language as it is used as a medium of T&L in the mathematics classroom as well as a particular focus of learning itself in the mathematics classroom



Appendix I: Thandiswa's beliefs

Belief No.	Data	Location	Belief type	Belief area	Transcription	Belief Statement (Prefix "This teacher believes that…")	Notes/thoughts
T1	Tha-initial	44-68	prompted	0	Me: ok… now… with Xhosa, obviously, you speak it very well Tha: ja! Fluently Me: /Absolutely/ Tha: mm Me: and you write it well? Tha: ja! Me: and English? Tha: English… mm, I can't speak. Me: oh, I think you can? Tha: mm? (sounds like 'really'?) Me: Just maybe you don't feel confident? Tha: ja! Ja! (agreeing) Me: mm, ok Tha: / don't feel confident/ Me: and written? Tha: oh, very confident Me: very confident? Tha ja: Me: with writing? Tha: with writing… Me: ok, so you feel, like, stronger with the writing Tha: ja Me: than with the speaking Tha: mm-hmm (yes) Me: ok	affective (Thandiswa's belief about herself): Thandiswa does not believe her spoken English proficiency is good	

T2	Tha-initial	--	prompted	0	See T1	affective (Thandiswa's belief about herself): her English writing skills are better than her English oral skills	
T3	Tha-initial	183-192	explicit	0	Me: um… and I'll leave you to, uh, Tha: (laughs) Me: … have some fun colouring Tha: I'm not good at colouring Me: oh, it's not about how 'brilliant' an artist you are Tha: is it? Me: it's about you representing yourself Tha: mm Me: in a way that you feel is accurate for you Tha: hmm! (chuckling)	Thandiswa doesn't seem to have good self-esteem	similar to Zolani: see Z122
T4	Tha-initial	193-200	explicit	0	Me: It's a nice way to describe Tha: oh? Me: Ja! Tha: I didn't know you could describe through a drawing. Me: Why not? Tha: I didn't know. Me: Yeah, it's a diff.. New way of trying it Tha: You always learn new things	Learning is an ongoing process not limited to school and classrooms	

T5	Tha-initial	236-247	prompted	1	Me: or um, you know, it was very fragmented? A lots of days… you missed out on a lot of days? Tha: ya, a lot of days we missed out Me: ok Tha: in 87, so we didn't write at that time. Me: mm ok. Do you think that it impacted on your education very heavily? Tha: mm I think so. I think so, in some way. Me: In some way? Bad way or good way? Tha: Bad way Me: bad way… ok so you feel like you didn't get the full… Tha: maybe I would have finished earlier Me: ok Tha: mm-hm	Thandiswa believes that disruptions to contact time impact on the ability to finish the curriculum.	This is an interesting idea when compared to the amount of contact lost during the school weeks when I was present in the village. I have no hard proof, but I often got the distinct impression that Thandiswa was not overly keen on the number of missed lessons.

T6	Tha-initial	236-289	prompted	0	Tha: ja, because we were the only two! Me: really? Tha: we were two, me and my friend… in the /class/ Me: how, how big was your class? Tha: it was very big! Me: ja? Tha: and there were… we were dominated by males Me: yes, absolutely Tha: mm… Me: /but you stuck your ground?/ Tha: worse it was during that time Me: mm, ok… Tha: 89? 90? Me: uhuh? How did that make you feel? /Being the only two girls?/ Tha: oh, we were very proud. Me: you were proud of yourselves? Tha: mm (yes) Me: you weren't scared? Tha: mm-mm (no) Me: you would show the /boys/ Tha: ja!! (laughing) Me: is that quite a… Tha: it was good!! Me: is that quite important to you? Being, um, empowering girls? Tha: /ja/ Me: empowering women? Tha: ja, it's very much good, I always tell those girls, they have to be empowered	Girls/women are capable of the same things as boys/men.	This should not be read as a complete belief in gender equality, but at least in gender-competency equality.

T7	Tha-initial	290-297	prompted	0	Me: empowered… and do you think mathematics is very Tha: /mm/ Me: important for empowering women? Tha: mm! (yes!) Me: why so? Tha: There are a lot of opportunities! Me: mm Tha: when you're doing maths	Mathematics offers opportunities to students	Thandiswa combines this belief with her belief about girls being empowered to conclude that girls should strive to succeed at mathematics as a mechanism of empowering themselves.
T8	Tha-initial	298-313	prompted	6	Me: mm, mm…. do you think that …. Do you think the girls are better than boys at maths? Tha: they are better! Me: are they? Tha: but they are too lazy. Me: they're lazy? Tha: *laziness*. Me: boys and girls? Or just the girls? Tha: all! The boys and the girls! Me: /all lazy/ Tha: but I think uh, uh girls are better than the boys Me: at the mathematics Tha: mm Me: they have more talent do you think? Tha: Ja! Mm-hmm Me: interesting, ok. Um, I'm inclined to agree with you because I'm a girl who likes mathematics you see so… Tha: (laughs)	Girls perform better at mathematics compared to boys.	Quote this when discussion the teacher's mental models of the students as 'lazy' ?

T9	Tha-initial	--	explicit	1	See T8	The students at the school are lazy.	This is a recurrent theme throughout the teachers' interviews and discussions. It seemed to be a favoured narrative in the classroom--perhaps one woven as a coping mechanism for teachers who don't know what else to do to increase attainment at the school against extreme odds? What does this say about teachers' resistance to certain alternative narratives, or their willingness to engage with certain evidence that might shift their beliefs about the world and their students? Would admitting evidence that countered the narrative of "lazy students" involve admission of other contextual situations that might be overwhelming?
T10	Tha-initial	--	led	6	See T8	Girls better performance at mathematics is due to innate ability rather than diligence or application	

T11	Tha-initial	324-338	prompted	1	Me: and did you get an opportunity during that to work *in* /schools/ Tha: mm hmm ja Me: Ok, so mostly school-based Tha: mostly ja Me: /do you think that was a good thing?/ Tha: we have to go to schools … Me: and teach Tha: and teach, ja /for the training/ Me: was that good? Tha: ja! It was good. Me: Why? Do you think experience is better? Tha: ja Me: ok… Tha: because it give you experience and then what do you have to expect when you in classroom situations Me: ok	Classroom contact time is important as part of teacher training for experience and expectations	Thandiswa went on to speculate that, despite getting the opportunity to do school-based training, her course was more theoretical. She didn't seem to think this was necessarily a good thing.
T12	Tha-initial	351-356	prompted	0	Me: um… mathematics at school for you: did you do well at school in mathematics? Tha: mm hm (yes!) Me: ja? It was a strong subject for you? Tha: ja, ja Me: uhuh Tha: I was doing maths and science.	Thandiswa seems to feel that maths is her strong subject academically--she is relatively confident in her subject knowledge	Contrast this with Zolani who admits maths was not her strength at school but went on to specialise in it anyway, and Simphiwe who dreaded mathematics as it was completely outside her area

T13	Tha-initial	365-378	prompted	7	Me: great. What language did you learn maths in? when you were at school? Tha: English oh yes Me: English only Tha: mm Me: your teacher only spoke English in maths class? Tha: No, there has to be code-switching always, ja Me: ok um, but your final exam was in English hey. Tha: English Me: how did you feel about that? Tha: sho! There's a difficulty in understanding the question …maybe you know how to do this Me: mm Tha: but you don't know what is being asked! Me: ok Tha: because there are some questions like that	Code-switching is a necessary part of teacher-talk in classrooms like the one Thandiswa attended as a student (and potentially the one she teaches in now)	Am not sure if Thandiswa's own English proficiency here has caused her to phrase a description as an imperative statement?
T14	Tha-initial	--	implicit	7	See T13	Assessments in English test the students English rather than their mathematical knowledge	

T15	Tha-initial	--	explicit	7	See T13	Question interpretation is a barrier to student attainment in mathematics assessment situations like exams.	Thandiswa relates back to difficulty she experienced in her own final assessment: this relates to her other beliefs about the difficulty of question phrasing for non-English speaking students. Refer to other sources (examiners commenting to press, Umalusi etc.) where similar concerns have been raised about mathematics and science NSC exams being phrased obscurely.

T16	Tha-initial	387-407	explicit	5	Me: you see they've (the grade 9 books) got a lot of symbolic questions, but the grade 8 book is a lot of words—do you think that that's what makes it more difficult Tha: mm Me: for the students? Tha: I think so Me: ok… Tha: I think so, in some way Me: in some ways? Could you explain that further for me? Tha: (pause) I always say they are too lazy Me: ok Tha: because some of the exercises, as you can see, in this one: it's just 'solve'. Me: ok Tha: You see? Me: it's just… it's just dril/ling/ Tha: /just/ 'solve' Me: it's just a drill Tha: ya, it's just a drilling: in some of the question papers there are questions that are like this and then they can't even move Me: ok, interesting! Tha: mm Me: so there's not a language problem there Tha: mm-mm (no) in some of the questions there's not a lot of languages. Me: ok	The students lack of effort is due to personal motivation, not lack of understanding.	The narrative of student's lacking agency is a powerful explanatory presence for what the teachers see. Also: Thandiswa seems a little confused by the distinction I am trying to draw between the two books--in this confusion, her default fall back is that the source of the problem is students' laziness [try to dig up that quote on unclear issues being the most exposing of beliefs?] Note: how can I relate this to Green's model where a "reasonable belief" is one which is based on the *available* evidence to a person, compared to a *reaonable believer* who bases his/her beliefs on all the evidence available to them?
T17	Tha-initial	--	explicit	7	See T16	For some of the questions, language is not a barrier	

T18	Tha-initial	--	implicit	7	See T16	Lack of understanding language is not laziness, but lack of understanding mathematics is.	I wonder how much this distinction is informed by Thandiswa's own mastery of the different areas. She sees herself as strong in mathematics. She sees herself as quite weak in her second language. She also no doubt does not see herself as a lazy person. Hence working hard results in mathematics success, but not necessarily in language mastery?
T19	Tha-initial	410-422	explicit	7	Tha: I think, the only… the only learners who have a problem are those who sit mathematical literacy Me: ok Tha: because maths lit: there's a *lot* of wording. Me : mm Tha: they have to analyze the question first Me: ok Tha: before calculations Me: yes Tha: but in pure math? Me: there's more symbolic representation? Tha: there's more symbols Me: Do you, do you teach maths lit as well? Tha: ya, I teach maths lit in grade 12	Difficulty with language around mathematics is primarily in word problem*s, not symbols*.	Thandiswa's link of language to mathematics is regarding the students' ability to understand the mathematical content of the question, as opposed to the instruction?

T20	Tha-initial	437-451	explicit	0	Me: ok, and you /got a lot of homework?/ Tha: /during that/ time… Me: ok Tha: the teacher was always at the board explaining and doing the exercises and then gives you classwork Me: mm and you get on with it Tha: mm (yes) Me: and did you get a lot of homework? Tha: mm! (yes) Me: (chuckling) did you always do your homework? (Both laugh) I sometimes didn't… Tha: during that… at that time, discipline was instilled in us. Me: ok Tha: so you have to do your homework and at home you have to… your parent have to see that you are taking your books Me: ok, and, and your parents checked on you? Tha: mm (yes!) Me: /very strictly/ Tha: /The parents/ did check.	Thandiswa's own educational experience was disciplined	
T100	Tha-initial		explicit		See T20	Parental involvement and attention to school work supports teachers and keeps children 'disciplined' about their schoolwork at home.	This is really an important insight that Thandiswa raises. She seems to attribute a significant correlation between parental valuing of education and student success.

T21	Tha-initial	--	implicit	0	See T20	Discipline is not necessarily an innate characteristic but is inculcated by a nurturing environment	Consider how this contrasts with Zolani's view, whose conclusion was the same but her explanation of it was very different. For Zolani, "we were disciplined". For Thandiswa "we had discipline instilled in us". Zolani sees her discipline as an innate--positive--character trait of her own. Thandiswa seems more willing to acknowledge the social role in the development or under-development of 'disciplined' practices.
T22	Tha-initial	452-482	prompted	0	Me: mm ok… do you think that is now still the case? Tha: mm-mm (no), because I don't they are being observed Me: ok they're not… there's no kind of …support at home Tha: there's no support! Me: for what the teacher's doing Tha: mm-m (no). Me: ok (pause) Why do you think that is?	The students Thandiswa teaches do not have the same discipline that was enforced in her time as a student.	Thandiswa seems to infer that discipline is an important precursor to students' success at school, but her beliefs about why her students are not so disciplined is less about the students' innate characteristics, but also to do with their circumstances. This clashes somewhat with her belief earlier about the students 'being lazy'.

T22	Tha-initial	452-482	prompted	0	Tha: I think, um, you see here, some of the learners are staying with their grandparents Me: mm.. Tha: they are old. Me: ok Tha: I think there's that's a problem Me: mm Tha: Their parents are staying maybe in Johannesburg Me: k Tha: they are in towns, their parents. Some of them are staying alone! Me: some of the children here? Tha: mm! (yes!) Me: they're parentless households? Tha: Mm Me: really? that's, that's very difficult to work… Tha: mm m (yes) Me: …focus on studies. Tha: it's very heavy Me: do they have to look after younger siblings as well? Tha: ya Me: ok Tha: some of them Me: so child-led households Tha: mm Me: ok… ya, no that makes it very difficult to sit down and do maths homework	Further evidence for T22	
T23	Tha-initial	--	implicit	0	See T22	Parental presence is important to maintain a focus on studies for students.	Quote Fleisch here where he discusses the differences between parents and grandparents in hands-on parenting.

T24	Tha-initial	484-495	prompted	6	Me: do you feel… do you feel that you've been given opportunity enough to, to know the mathematics you need to be a good maths teacher? Tha: no, no Me: ok? Tha: I still need some training in some of the work Me: some of the work Tha: ya Me: ok, you haven't had opportunity to develop that yet Tha: mm mm mm I was very interested in… there's a project that Rhodes (University) says they are going to give us in maths Me: ok! Tha: So, I did register on that because I still need something Me: you're still feeling you need to upgrade your skillset /more/ Tha: /ja ja/	Thandiswa does not believe that her current subject knowledge is sufficient for her work.	
T25	Tha-initial	542-551	prompted	2	Me: Um, all languages… do you think that they are equal to each other or… Tha: (chuckles) Me: .. not? Tha: not! Me: not! Which ones do you feel are stronger Tha: I think the English is the one that is strong Me: why do you think so? Tha: because everything is done in English Me: everything is done in English Tha: mm	Different languages provide different levels of access to opportunities and resources.	Thandiswa is expressing here a very Boudieu-like theme of cultural capital. Her discussion of the language for 'interviews' shows at the local level the very real prioritiy of many marginalized communities to acquire English as a mechanism to economic opportunities and resources
T26	Tha-initial	--	explicit	2	See T25	English is the powerful language in Thandiswa's world	

T27	Tha-initial	556-567	explicit	2	Me: It's not like English is… Tha: because its… also in interviews they are saying we must have… 'you must learn your language' but when you come to an interview, you see that English is the one that is /dominating/ Me: /opening the doors/.. 'dominating' yeah… it's not because English is prettier or… Tha: ya Me: … it just gives you more, more 'access' Tha: mm Me: because you're already saying how you think Tshivenda sounds beautiful, and Afrikaans sounds beautiful Tha: mm Me: so it's not about how the sound is Tha: ya Me: it's just about *access* Tha: yes	English is necessary to access jobs.	
T28	Tha-initial	--	prompted	2	See T27	The value of a language is in its ability to give access, not its aesthetic	

T29	Tha-initial	568-576	prompted	7	Me: mm. Um do you think that there's right ways and wrong ways to use language? So, like code-switching… sometimes you might say 'oh but that's not real Xhosa!' That's not real English Tha: mm Me: do you agree with that? Or do you think… Tha: mm Me: … um, you just use what you can and you get on with it? Tha: I just use what I can Me: … and get on with it. Mm, so it's not really important Tha: it's not important, I don't think, it's important Me: /ok/ to be super like 'perfect' Tha: mm mm (yes)	Modelling good use of language is not a priority in a mathematics lesson	
T30	Tha-initial	599-604	prompted	7	Me: um, what languages do you think children should use to learn their subjects in: not just mathematics, but all their subjects? What do you think is the best language? Tha: I think English is the best Me: mm Tha: although it's a foreign language I think it's the best Me: mm Tha: because code-switching from English to Xhosa.. it's very difficult.	English is the most appropriate language for learning mathematics, even in non-English speaking communities	Thandiswa's belief about English as the most suitable LoLT is founded upon her perceived need to avoid code-switching. Surely then mother-tongue would be best as no code-switching is required at all? See T31
T31	Tha-initial	608-614	explicit	7	Tha: because some of the words, you can't code-switch! Me: ah! So there's an absence of some words in Xhosa Tha: mm (yes) Me: do you find though that if you speak English the children don't understand? Tha: They don't understand, they just look at you	The lack of subject specific vocabulary is what makes isiXhosa unsuitable for teaching mathematics.	

T32	Tha-initial	--	implicit	7	See T31	Explaining concepts is dependent on using their names	
T33	Tha-initial	636-643	explicit	4	Tha: I think English is best, but it doesn't mean we have to move away from Xhosa Me: ok Tha: mm Me: you think that it's, it's possible to have both Tha: ja! Me: in a constructive way? Tha: mm, in a constructive way Me: ok	One language can be acquired without others being lost (additive multilingualism)	Thandiswa is quite passionate that acquiring skills in English does not mean that she has to forget about isiXhosa. This contrasts interestingly with the perspectives of those who see isiXhosa and other indigenous languages as a mark of being uneducated--need to find some references regarding students who have attended ex-model C schools who cannot speak their family's native language as they've experienced language shift to English.

T34	Tha-initial	649-656	prompted	7	Me: mm ok… do the textbooks pose problems ‘cos they’re English? Tha: no, not for me Me: (pause) and the children? Do they often say to you ‘Miss, what does this mean?’ Tha: mm… Me: point at word and say Tha: ja, ja Me:…”please help me understand” Tha: they always do that	The terminology in mathematics textbooks does not pose a challenge to Thandiswa	
T35	Tha-initial	--	prompted	7	See T34	The terminology in mathematics textbooks *does* pose a challenge to her students	
T36	Tha-initial	--	implicit	4	See T34	The students are dependent on Thandiswa to help them decode the textbook	

T37	Tha-initial	667-676	prompted	5	Me: a lot of people say that maths is not words, maths is symbols. (pause) do you, do you agree with that? Tha: I agree with that. Me: you agree with that. Tha: mm (yes) Me: ok, so you don't think… Tha: maths is not words. Me: it's it's symbols Tha: mm Me: so you don't think that the words should get in the way Tha: ya	The use of symbols negates the need for language development in mathematics.	The symbolic nature of mathematics means it is removed from language: Thandiswa is very clearly tying the *written* form of mathematics to the *written form* of language and saying 'these are very different visually'. However, the *verbal* forms are incredibly similar. Could this have something to do with Thandiswa's expressed difference in her confidence and proficiency in English in the written form when contrasted to the verbal form? How does this contrast with her effusive expressions about the written questions in exams and their phrasing?

T38	Tha-initial	685-695	prompted	6	Me: if you spoke to a good maths student, or you gave them a problem that looked a little bit like… um, this one here (indicates a question in the textbook) with, um, solving an equation with a fraction Tha: mm hm Me: what would a good maths student know to do straight away? Or not to do? Tha: ah… not to do, is just separating some… they know that they have to move the other one to the other side neh? Me: ok Tha: so, if, if he or she subtracts, I'll know he doesn't know anything about mathematics Me: ok Tha: mm Me: so if they st… sort of start, um, they just subtract the one side but not the other Tha: mm, mmhm (yes) Me: ok	Correct procedural execution counts as evidence of mathematical understanding	The facts that Thandiswa explores are more mathematical conventions than examples of relational reasoning. This could be a result of the curriculum, most of which is centred around mastery of mathematical conventions and applications of 'facts' rather than demonstrating argumentation methods (i.e. proof). How does this apply to Green's model of different types of knowledge, and where mathematics occupies a unique position in this model as a priori and analytical? [see notes for discussion on how synthetic/evidence-based curricula and teaching methods are expected to result in analytic reasoning].

T39	Tha-initial	696-724	prompted	6	Tha: ok, let's, let's look at this one Me: mm? Tha: this is '4b is equal to 24' neh? Me: mm Tha: I'll know, I'll know she does, she does understand maths if he divides by four Me: ah, ok Tha: knowing the, the multiplicative of... uyabon'? Me: so she understands that the '4b' means Tha: mm (yes) Me: 'four multiplied by b' Tha: understanding the... BODMAS Me: yes Tha: which one to start Me: ok, ya Tha: BODMAS I think that Me: ya... Tha: that is the one.	Knowledge of mathematical conventions and facts counts as evidence of mathematical understanding	In terms of Ernest's model of different mathematical epistemological models, this is definitely falling into the 'procedural' category. Discuss this and cite this quotation. The solution of this problem has nothing to do with BODMAS at all, but rather the relationships between inverse operators?

T39	Tha-initial	696-724	prompted	6	Me: ok… good, so immediately you'll be saying… Tha: mm Me: 'does this student understand what the symbols are telling them?' Tha: mm, mm Me: does the student know things like, ah, balancing an equation? Tha: balancing an equation! Me: does the student know things like… the order of operations Tha: ya! Me: what must happen first Tha: ya ya I think… Me: the order to undo things Tha: I think that's the first! The order of operations.	Further evidence for T39	
T40	Tha-initial	727-730	explicit	6	Me: when you're teaching mathematics what's the *best* way to try and ensure maximum understanding? Is it to do lots of different questions? Or lots of the same question? Or to get students to work in groups? What do you think is the best way of learning mathematics? Tha: give them a *lot* of exercises and then they have to work in groups. Me: ok Tha: that's what I always encourage them to work in groups. Me: ok.	Doing lots of exercises is the mechanism to mastering a mathematical topic.	Need to be cautious of the demonisation of 'drill-work' in the mathematics teaching reform movement. There is some research coming out that says neither is 'good' or 'bad', but rather how it's done is what can be problematic (references?). Suspect we're seeing here Thandiswa replicating her own experience of mathematics learning in her classroom.

T41	Tha-initial	--	prompted	1	See T40	Students work well in groups	Thandiswa's notion of 'groupwork' is not necessarily mine (Speer): each child is doing the same task, but they are allowed to support each other with it. There have been issues raised re. OBE regarding the blind advocacy of 'group work', particularly regarding strong students masking weaker ones.
T42	Tha-initial	731-738	prompted	1	Me: What do you think is so beneficial about groupwork? Tha: I think also to, to the one who is maybe delivering to them, he gets a knowledge, more knowledge because he's... he'll be able to assist the others Me: ok Tha: mmm Me: so you think helping other people /furthers your own understanding/? Tha: ja, <indiscernible> ja! Me: and for the weaker students? Do you think that learning from a peer is better? Tha: ja! It's better! Because he... he or she will be able to ask from her peer, not from (the teacher)	stronger students develop their understanding further by explaining to their peers	Thandiswa is not considering the difficulty if the students posture or pretend to understand so that they can please her. Also: who is the 'person-supposed-to-know'? BUT: there was quite a bit of evidence in the observations that students checked in with the teacher when they weren't sure amongst themselves.
T43	Tha-initial	--	prompted	1	See T42	Weaker students will probably feel less shy to learn from their peers	

T44	Tha-initial	739-750	prompted	6	Me: ok, and they.. they have more opportunity Tha: mm mm Me: …to engage Tha: to interact with each other Me: ok… very interesting Tha: because maybe some of them, they don't want to ask when I'm standing there Me: mm Tha: they don't want call me because they think, some of them will laugh Me: *baneentloni* (they are anxious/nervous) Tha: mm (yes) *baneentloni* Me: mm I hear you… ja, maths can be quite intimidating Tha: mm! (yes)	Mathematics can be an intimidating subject	It would've been nice to have explored this a little further (Thandiswa's feelings about mathematics, and how she perceives her students' feelings towards the subject).
T45	Tha-initial	--	explicit	1	See T44	Students are nervous to ask the teacher a question in front of their peers for fear of making a mistake and being ridiculed.	

T46	Tha-initial	763-776	explicit	5	Me: ok, um, we've already said maths words start to create a difficulty for the students Tha: mm Me: is that because of the lack of a translation or because the spelling's difficult… or because the meaning is very …complicated? Tha: I think the meaning is very complicated… Me: ok… Tha: it's not about spelling Me: mm, its, its… Tha: it's the meaning Me: a very precise meaning and the definitions Tha: mm mm Me: are quite complicated aren't they? Tha: because it it… that word will only focus to maths Me: mm Tha: you won't see it in other …things	Mathematics terminology is very specific: it doesn't crop up in other contexts	Thandiswa of her own volition points out the 'foreignness' of certain mathematics terms that are 'found nowhere else'. Setati and Adler: this school definitely falls into EFL. Also reference and discuss the idea that anglophone students still struggle with context-reduced mathematics terminology that is not found or used in everyday parlance.

T47	Tha-initial	783-805	led	7	Me: I was thinking about the word the other day… um, “power” Tha: mmhm! Me: because of course… I don’t know if in _____, we didn’t have electricity here yesterday Tha: mm-hm Me: …and I thought to myself, well, in Xhosa you say ‘umbane’ Tha: umbane, ya Me: you don’t say ‘amandla’ Tha: ya!! Me: but in English the word ‘power’ can mean ‘elec/tricity/’ Tha: /elec/tricity mmhmm Me: but it can also mean 'strength' Tha: mmhmm Me: but in mathematics, it also means? Tha: (chuckling—she has realised where I’m going with this) Me: an exponent! Tha: mmhm oh, ya! Me: so for a student, that word ‘power’ must be very confusing! Tha: mm mm Me: because… Tha: there’s a lot of meanings Me: it has a lot of different meanings Tha: mm hm (agreeing) Me: um… there’s quite a lot of those in maths aren’t there Tha: mm hm (agreeing)	English terms in mathematics that have multiple meanings can be confusing	Thandiswa acknowledged my proposition that a word such as 'power' could cause problems (we drew on 'umbane' and 'amandla' as examples of how translations don't work).

T48	Tha-initial	809-816	prompted	5	Me: um, do you think that they actually have to know these words to know mathematics? Or can you *know* mathematics without knowing the word ‘exponent’ or ‘reciprocal’ or… can you know mathematics without knowing the words? Tha: I think so Me: you do.. Tha: ya Me: ‘cos you were saying earlier it’s the symbols… Tha: it’s the symbols, ya Me: …not the language Tha: …not the language.	Mathematics can be known without knowing the correct 'label' for each idea	We picked up on the idea that a *signified* is independent of it's *signifier* here, and only touched briefly on how drawing this distinction doesn't help when concepts have to be explained. But this belief ties in with Thandiswa's beliefs about mathematics 'not really needing much language' as evidenced in it's written form. The conflict arises when moving to the verbal domain.

T49	Tha-initial	817-832	prompted	5	Me: and do you think that to talk about mathematics is different, say, to talking about geography? When you're talking mathematics in the classroom Tha: mm hmm (thinking) Me: Do you think you need to use language that's very… *specific* to mathematics? Tha: ja! Me: it's not the same as talking about geography Tha: /it's not the same/ as talking about geography or tourism Me: mm Tha: it's not the same Me: it's not the same, it's quite specific… Tha: mm mm Me: interesting, ja Tha: and then there's a little ma… there's a little language in mathematics Me: mm Tha: because it's always symbols Me: symbols as well Tha: symbols	Talking about mathematics is different to talking about other subjects in the curriculum.	Thandiswa is quite sure that maths-talk is not like geography-talk or tourism-talk. She refers back again to the 'sparcity' of language in mathematics. Thought: how much of the mathematics learning is occuring in written form and how much in verbal? Worth looking at the observations again to find the disjuncture between the two communication domains. This would certainly go some way to explain why test results and book evidence do not match conversational evidence from the classroom.

T50	Tha-initial	840-854	led	5	Me: do you think they phrase it in a way that makes it more difficult... Tha: ja! Me: ...to understand? Tha: ya Me: do you think they could make it more simple? Tha: mm hmm (yes) Me:... and do you think that would help the students? Tha: that would help the students. Sometime maybe I will.. I will give you a, um, grade 9 question paper... Me: mm Tha: ... and you will *see* the wording... Me: mm Tha: *very* complicated for those learners Me: mm... and do you think that that should be... rephrased? Tha: ja, that should be rephrased Me: ok...	Mathematics exam questions could be phrased more simply and this would assist students.	This relates back to Thandiswa's prior expression of her own final maths exam where 'understanding the question' was the major barrier, not mathematics mastery. Also see T9. Thandiswa also admits that even the teachers have difficulty in deciphering the questions [wonder what kind of access they have to past papers?]

T51	Tha-initial	855-874	explicit	5	Tha: you struggle, even you, you're the teacher you struggle 'what does this mean?' Me: 'what are they asking for?' Tha: 'what are they asking?' Me: 'what are they asking me to do?' Tha: ya! Sho sho sho Me: and I imagine, I imagine that must… Tha: we always say "I don't know where, where are they coming from… Me: yes Tha: …these people who are setting these papers Me: yes Tha: where are they coming from? From another planet?! Me: (laughs) Tha: maybe there's another planet somewhere Me: absolutely! Tha: sho sho sho Me: it's really phrased in a very specific way isn't it? Tha: ewe! (yes) Me: you kinda need to learn how to read the paper Tha: Tyhini! (seriously!) sho, ah ah, it's too much. Me: absolutely!	The teachers struggle to decipher exam questions	Thandiswa feels strongly about this point (she goes as far as saying, in jest, that the exam authors are extra-terrestrials)

T52	Tha-initial	874-889	explicit	1	Me: I imagine that must make you feel really frustrated as a teacher Tha: ya! *Very* frustrated …when they are going to write the, the maths paper in the final… Me: mm? Tha: we are very scared… seem… seems like you didn't do anything! Me: mm and you feel like you're being judged on that? Tha: mm mm Me: Mm but it's… Tha: yoh, /it's too much/ Me: this barrier that… you and your students can't… Tha: ja! … Me: climb *over* because of the language? Tha: ja.. and you, you just taught… you tell yourself "oh, when they are writing the maths paper, I don't want to come to school" Me: mm Tha: because you see them… Me: do you think the students blame you? Tha: (pause) obviously!	Students results do not reflect the teachers efforts	Thandiswa's sense of unfairness in what happens in exams related to her efforts in the classroom is palpable. She does not think that the 'blame' attributed to her by the students is fair. Does this go some way to illustrating why the teachers always blame the students? The teacher-student relationship here seems strained, not one of mutual respect or cooperation. What does this mean for power assymetries (which certainly benefit the teacher?)
T53	Tha-initial	--	implicit	3	See transcripts from T37, T38, T39	Mathematics is symbol manipulation	Thandiswa often refers to there 'not being much language' in mathematics, focusing on the written form and distinguishing between 'language' as written words, and symbols whose names are not reflected in their written form.

T54	Tha-initial	901-911	led	7	Tha: whereas in maths is only about, eh, symbols and what have you, Me: mm mm Tha: but you see, the questioning, the rephrasing, it's too much complicated for the learners Me: mm mm and then you're not assessing their mathematics Tha: ja! Me: you're actually assessing /their English/ Tha: /ja, they're not ass../ ja, ja Me: assessing the English… Tha: mm mm Me: (pause) but it's a maths exam Tha: it's a maths exam	Mathematics exams are not assessing mathematics prowess but English mastery	This contradicts Thandiswa's strong conviction that mathematics doesn't need much language

T55	Tha-initial	918-934	prompted	7	Me: mm (pause) um… when the learners are talking about mathematics in groups Tha: mm Me: do they mostly talk in isiXhosa? Tha: (smiling) obviously Me: and then do they give you the answer when they're finished Tha: ja… Me: in English? Or in Xhosa? Tha: some of them they give in English Me: mm Tha: some in Xhosa Me: do you feel… do you try and correct their English when they make a mistake or do you just let them try express themselves? Tha: I just let them express… Me: ok, but you… Tha: but as long as the answer is correct Me: mm Tha: the mathematically… Me: mm, you're interested in the maths Tha: ya!	Communication should be prioritized over 'good' or standard forms of language use in the mathematics classroom.	This belief confirms Thandiswa's delinking of mathematics and language. It also exposes her beliefs about her role as a teacher-of-content and not a teacher-of-language. As one of the few English-speaking role models that students have access to, this could be debatable. Setati? (teacher of content and language?). Thandiswa does not seem to experience Adler's "Dilemma of Transparency" as the language is not an object of teaching to her.

T56	Tha-Likert	n/a	prompted	7	--	1. Students shouldn't really use dictionaries in class to help them with their work	Thandiswa did not phrase this as strongly as Zolani, who seemed to have thought about it a bit more explicitly. However, she did have an inkling of the idea that maths words are often not found in standard school dictionaries.
T57	Tha-Likert	n/a	prompted	1	--	2. As a teacher, I definitely feel I have a strong influence on the lives of my students	Contrasts with her feelings of not being able to do anything to change students' results?
T58	Tha-Likert	n/a	prompted	6	--	3. Some students definitely won’t ever really get maths	Attribution of fixed/ innate mathematics ability in students.
T59	Tha-Likert	n/a	prompted	1	--	4. Students don't really learn more when taught by the teacher than when taught by each other	This is supported by her other beliefs in Tha-initial
T60	Tha-Likert	n/a	prompted	4	--	5. The burden on English teachers is definitely greater than others because they provide students with the language they need to learn	This is interesting in contrast with the English Grade 9 lesson I watched for the same class!
T61	Tha-Likert	n/a	prompted	7	--	6. Talking about maths (in any language) is definitely no different to talking about other subjects at school	This contradicts my discussion with Tha in her initial interview.

T62	Tha-Likert	n/a	prompted	3	--	7. There is definitely more than one way to solve a particular type of maths problem	
T63	Tha-Likert	n/a	prompted	4	--	8. A student definitely cannot use a language for learning without being able to *speak* it.	Conflicts with T48
T64	Tha-Likert	n/a	prompted	6	--	9. Students definitely need to learn maths that is not covered by the school curriculum	
T65	Tha-Likert	n/a	prompted	6	--	10. Learner-centred approaches (like OBE) definitely work well for teaching mathematics	

T66	Tha-final	40-54	explicit	0	Me: tell me about them (a particular table of students)… strong? Weak? Just lazy? Or actually they work hard but they struggle? Tha: ya, they are really trying Me: mm Tha: they are trying Me: they are trying hard? Are they, are they reaping the results? Tha: they are really keen to do the work Me: ok Tha: but the only problem that these learners ha-have, is just not practicing at home Me: ok Tha: they are only practicing when they are in class. Me: mm Tha: and then you can see they are… they *do* want to learn Me: mm, so they are keen in class Tha: ya! They are keen in class Me: mm	Some of the students in class are keen to work.	This contradicts much of the deficit model of the students that has come from the other teachers. Thandiswa has expressed that the students are 'lazy' but has also displayed a greater sensitivity to the circumstances that prevent students from achieving. Overall, Thandiswa's opinion of the students is a lot more sympathetic than Zolani's. She seems to think more of them.
T67	Tha-final	--	explicit	1	See T66	The major setback for students to achieve their goal is not working at home.	

T66	Tha-final	58-67	prompted	0	Me: then we've got the table of girls here in the middle (panning around to the next table) Tha: (chuckles) mm-mm Me: what are they like? Tha: ya, they are good. Me: they are good? Tha: mm… but there's this one (indicates a specific student) Me: over here? Tha: ya, this one is struggling Me: she's struggling a little bit Tha: ja	Further evidence for T66	

T68	Tha-final	65-92	explicit	0	Tha: ya, this one is struggling Me: she's struggling a little bit Tha: ja Me: um, do you have any ideas why? Tha: eish… (thinking) I don't know, because she was not here last year Me: oh, has she transferred? Tha: she only came here… ya, she was transferred, she's from /PE/ Me: which school was she at? From PE Tha: mm Me: ok Tha: she's from PE. Me: ok Tha: and also this one (indicating a different student), on this group Me: oh /in the big…/ Tha: /this one/ Me: this one here? Tha: ja, she's from… is it in East London? Me: ok… Tha: East London, also that one is struggling… Me: ok	moving schools causes academic difficulties for students	Thandiswa certainly seems to think that transferring schools makes things more difficult for students academically. She also alludes to the fact that she has less insight into these students because she doesn't know them as well as the others. She certainly seems to know details about each of her students quite specifically--she singles out individuals as we pan around the classroom and gives commentary on individuals. This contrasts quite strongly with Zolani who didn't single out students much at all: she talked about the tables as homogenous units.

T68	Tha-final	65-92	explicit	0	Tha: and there's another one on that group which is also struggling, ja, that's this one (point to the video) Me: oh, here on the left Tha: mm-mm (no), this one (points at different student) Me: ok Tha: ja Me: ok Tha: and also, this one is not from here… I think she's from Cape Town Me: ok	Further evidence for T68	
~~T69~~	~~Tha-final~~	~~-~~	~~explicit~~	~~0~~	~~See T68~~	~~longitudinal knowledge of students assists in diagnosing their learning difficulties~~	~~See T68~~

T70	Tha-final	104-115	implicit	1	Me: now we've got these two boys at the back Tha: ah, this one is good (pointing at one of the students) Me: on the left here? Tha: ja! This one is good… but he, he's always playing Me: mmm, 'k Tha: that's, /that's his problem/ Me: (chuckling) Tha: otherwise he, he can be ..somewhere Me: ja Tha: this one Me: ok… so he's got potential you think Tha: ja, he's got potential that one…	time on task is directly proportional to achievement	The difference in how the students are viewed between Thandiswa and Zolani is marked. Most comments from Thandiswa are positive and showing knowledge of their ability and their background. By 'playing' here I am interpreting Thandiswa to be saying 'not working'

T71	Tha-final	132-149	explicit	0	Me: And then these four boys at the back here Tha: (chuckling) Me: ohhh, (laughing) tell me about them! Tha: /these four/… Me: what about them? Tha: I'm not sure… something about age on those Me: are they slightly older? Tha: Ya, they are older these two, Me: mm Tha: these two Me: /ok/ Tha: /they/ are old… then they are repeating grade 9 Me: ok Tha: those three, one, two, three Me: are there /any other repeaters?/ Tha: /they are/ doing it for the third time this year Me: third time? Ok, so… they are quite a lot older than the others Tha: they are older …	Older students struggle more with their learning.	Also see Z14: a similar sentiment from Zolani Note: through my own experience as head of mathematics in a high school, I discovered that the promotion criteria for Grade 9 are different for those from Grade 1 to Grade 8. This leaves a lot of students stranded in Grade 9 as they then have to meet more stringent passing criteria that they had not encountered before.

T72	Tha-final	149-157	explicit	0	Tha: I am really worried about that one because there's that other one who's from grade 8 Me: mm Tha: who is doing grade 9 for the first time Me: mm Tha: and he, he is staying with them Me: oh he's mixed in with the group /repeating/ Tha: ya ya Me: you are worried that that is going to influence him? Tha: ya! It's influencing him	Younger students may be negatively influenced by older students in terms of their academic performance and effort	this is similar to Zolani's concern about strong peer influence in the groups of boys in her class
T72	Tha-final	173-176	prompted	0	Me: do you, do you think that the older students—well, I mean you've already mentioned the one student—the older students, um, are a... are a negative influence on the others in the classroom? Tha: mm (agreeing) in some way I think so Me: mm Tha: I really think so...	Further evidence for T72	

T73	Tha-final	176-182	explicit	0	Tha: I really think so… and I don't know how to solve it Me: mm Tha: because this is their school… they have to be here Me: well they need to be here Tha: ja Me: it's not a question of separating Tha: mm mm	The students have a right to be at school and should not be excluded.	This statement from Thandiswa also seemed out of place when compared to the narratives generally found in the interviews: that the students have *ownership in* the school and have a right to be there. She expresses her concerns about how to resolve the issue of older repeating students being a bad influence on younger students *without impacting on the students rights to education*. Most notable is that the students who are seen to be problematic are still being recognised as having certain rights and needing to be in school: a far more inclusive description that any other comments thus far.

T74	Tha-final	194-203	explicit	1	Me: how do you feel as a teacher when you can see that this student needs extra support but, you have to divide your attention between everybody? Tha: mm mm Me: I mean, how does that feel? Tha: you feel bad Me: yeah Tha: 'cos at the end of the day, it's gonna reflect on you Me: ya! Ya Tha: you feel bad Me: mm Tha: really bad..	Teachers should do what they can to support students in order to maintain their reputation	
T75	Tha-final	203-219	explicit	1	Tha: and then when you tell them they have to practice each and every day… and then when you come to their books you see, they haven't done anything! Me: ok? So you /think/ Tha: /then/ they they they don't even ask! Like, yesterday I went to their classroom because they are going to write maths on Monday Me: mmk Tha: I told them they have to start from page 1 Me: mm Tha: Practicing and practicing and then today Me: mm Tha: …they could ask me if they have a problem. Me: mm… so they haven't… you don't… Tha: I'm still waiting for them! Me: they haven't seen any… they haven't come across anything specific Tha: ya! Me:… to come say 'Miss _____ … Tha: …we have a problem here! Me: we have a problem here. Tha: That's what I want from them	Students are not applying themselves or leveraging the opportunities the teacher is giving them.	Thandiswa says 'I went to their classroom'… this could imply she popped in and gave them bookwork to do and didn't stay (this happened often, especially in the run up to exams when the teachers were doing exam prep work during lesson time). The expectation is for a lot of self-start energy on the part of the students in the absence of adult supervision. Is this a realistic expectation?

T76	Tha-final	222-233	prompted	1	Me: what else do you see in the books, other than the lack of practice at home? Do you pick up, do you pick up any copying for example? Tha: ya, they do that. Me: they copy? Tha: ya, they do that. Me: mm, ah… Tha: they copy each other's work Me: uh, why do you think they are doing that? … just to kind of say 'look Miss!'? Tha: "I've done it!" Me: "I've done it" Tha: mm, and then they get, uh, good marks.. Me: mm, so Tha: but at the end of the day when there comes a test, someone is unable to do it…	Students copy each others work to meet criteria of completion, not criteria of understanding.	This matches what Zolani says. Worth discussing here that neither teacher has identified themselves where this drive-to-show-completed-work comes from: most especially that it may be the game that they themselves have taught their students! If completion is rewarded or punished, that is what will be prioritized.

T77	Tha-final	238-257	led	1	Me: it's a bit of… sometimes I think there's a bit of a tension there because there's teaching them the mathematics Tha: mm Me: and then there's teaching them how to write a maths exam! And they are not always the same Tha: mm Me: So, um, do you spend more time working on the, um, on the mathematical concept or, for example, do you say to them 'look, you're working too slowly!' Look… um one student said in the second lesson—I think it was _____-- you know, 'how does the mark allocation work?' Tha: mm Me: I mean, that's not to do with maths, that's just to do with exam technique Tha: ja, mm Me: um… and also, um, I've noticed that kind of reading the question very clearly, modelling how to interpret what the question is asking Tha: mm Me: that's not really learning mathematics, that's learning exam technique Tha: ya, mm Me: do you feel like you have to juggle?	Assessment technique and question interpretation need to be taught explicitly	See T93

T77	Tha-final	238-257	prompted	1	Tha: yes, you have to! Me: and sometimes you can't cover everything? Because you're trying to teach them the maths, but you've also got to prepare them for this test Tha: mm hm mm hm (agreeing) Me: um Tha: that's what we have to do 'cos we have to, we have to prepare them for the test, and then the type of questioning Me: mm Tha: they are going to experience during the test time…		See T93
T78	Tha-final	258-268	explicit	7	Me: and if they could write their tests in Xhosa would you, would you think that would work? Would you like to give them that if you…. If, if it were possible? Do you think it is possible? To write a maths exam in Xhosa? Tha: I don't think it would change anything Me: you don't think it would change anything… Tha: mm mm (no) Me: ok Tha: because the numbers will be there, and then the expressions will be there Me: mm mm ok, so, really, actually, that's not the big deal here Tha: mm, that's not a big deal Me: ok that's interesting Tha: the signs will be there Me: ya, I hear you	The language of the test does not affect the outcome	This contradicts heavily with Thandiswa's prior statements about the opacity of questioning in the exams.

T79	Tha-final	286-297	prompted	6	Me: in fact, actually, I can't think of a single place in, in any adult job where you draw a stem-and-leaf… Tha: a stem-and-leaf diagram! Me: diagram. (both laughing) why do you think they put it in the curriculum? Tha: I really don't know!! (still both laughing) And then they are asking it on the question paper! Me: ya! Absolutely, to Both: draw a stem-and-leaf diagram! Me: I mean… it's a…it's a very good example I think of where maths… maths can be just about remembering… do you think there's a lot of memorization in maths? Tha: mm (yes) Me: a lot of kind of… you've gotta remember 'multiply the brackets' Tha: ya, ya (agreeing) Me: "a negative times a negative makes a positive"… there's a lot of memorization? Tha: mm mm	Mathematics involves a lot of memorization	This borders on 'led'.
T80	Tha-final	298-307	led	6	Me: mm and cumulative? Do you think maths is a cumulative subject? You need… by 'cumulative' I mean, you must know everything you've learnt before in order to learn the new material Tha: ya! You have to have the pre-knowledge Me: yes! Tha: mm Me: and if the student doesn't come with that pre-knowledge? What /can you do/? Tha: /they are/ struggling! Me: ya! I mean.. Tha: 'cos you have to go back Me: mmm Tha: and then you'll be running out of time.	Mathematics learning is cumulative	

T81	Tha-final	309-316	explicit	1	Tha: and then another problem they're having… Me: mm Tha: they are unable to ask "Miss I don't understand this—could you please assist me on this?" Me: mm, you think they maybe feel /at risk/? Tha: /at least/ you'll be able to make time Me: ya Tha: if the, a student comes to you and says "I've got a problem on this, could you please assist me?"… Me: mm…	These students lack the confidence to ask for help	
T82	Tha-final	316-323	prompted	1	Me: do you feel like your, one of your biggest challenges as a teacher is getting the students to show you where their problems are? Tha: mm (yes) Me: so you're actually just… you look at them and you think "well, I actually don't know how to help you because I don't know…where your /problems are/" Tha: "/what you/ don't have, what you don't know" Me: ok! That's very interesting. Tha: mm Me: very interesting… an… Tha: they have to ask!	The major challenge in teaching is formative assessment	Thandiswa is frustrated by the absence of students explicitly polling her for help on specific topics, and she seems unsure of how to use other evidence to diagnose their problems.

T83	Tha-final	345-366	prompted	1	Me: and then, what you did was.. they would offer you something—I think a binomial, you asked for a binomial and you said… one student said 'two x plus three x' Tha: mm Me: but you didn't say to him "hayi, no, you're wrong" Tha: mm Me: you took his offering Tha: mm Me: you put it on the board, and then you resolved why… Tha: mm mm Me:.. it was truly a monomial Tha: mm mm Me: and I think … I think that that has an impact on children… when you don't just say "no" Tha: "wrong!" ya! Me: ya, you agree with that? Tha: mm-hm (yes) I agree with that Me: ya, so working with… what, um, how important is that confidence… to try, even though maybe you're wrong… how important is that confidence? And what builds that confidence in a student, to try even if… Tha: even if, even if… what, what he has is not the correct answer, you have to accept it Me: mm mm Tha: in or.. Me: you think that's really important? Tha: ya! That's really important in order to make them don't lose… so that they don't lose i-confidence Me: mm Tha: or self-esteem	Rejecting students offerings affects their self efficacy	Use this vignette in the stimulated recall interview explicitly in the analysis chapter for Thandiswa

T84	Tha-final	373-388	prompted	1	Me: mm, praising and penalties… what do you think about praising and then, the other side of course is, is punishing Tha: mm-hm Me: you know, how do you… do you, do you feel that it's appropriate sometimes to punish students? If they haven't done, for example, homework? Or if they've /been naughty/? Tha: /I think/ it's appropriate (chuckles) Me: it's appropriate… what, well I mean that's absolutely fine because, um, I think, I think that's pretty much part and parcel of the job Tha: mm mm (agreeing) Me: what kind of penalties do you think work? Which ones are effective? Maybe giving lines? Keep them after school? Make them stay during break? I mean, what… what works? Tha: I think what works… just make them stand Me: make them stand? Tha: mm hm (yes) Me: ok Tha: then they write while they are standing Me: ok Tha: if he didn't write, or she didn't write classwork, they stand there and she writes while standing Me: mm ok… ya, I noticed one student she did that… and then you let her redeem herself by answer… Tha: by answering, ya mm	Penalties are sometimes appropriate for students who have not done what is required of them.	Thandiswa seems understandably a bit nervous about this question when asked "what penalties work?"

T85	Tha-final	389-398	prompted	1	Me: What do you think about homework? Do you… you don't set a lot of homework… is that because you know it just won't happen? Tha: it won't happen Me: ok Tha: but I do give them sometimes Me: ok just not in these lessons Tha: mm (yes) Me: ummm… Tha: because I know they are not going to do it… they are going to copy it Me: ya Tha: so it's better we do it /in class/	It is better to not issue homework if it is not manifesting in learning (e.g. it is not done, or copied).	This supports Thandiswa's earlier statements about home not being a conducive environment to school work.
T86	Tha-final	414-422	explicit	0	Tha: hmph! (takes a sip of tea) That one is energetic! Me: energetic? Tha: yeah, mm Me: um.. and how does he do in tests? Tha: oh, he does get good marks… Me: ok? Tha: but I am sure because of excitement, sometimes he doesn't do right Me: he's got too much energy you think? Tha: ya, too much energy (pause)	students may make mistakes if they are not calm and collected during assessments	This question was about the student "Anele" (see Chapter 5) who was enthusiastic and engaged in class, but also very energetic.

T87	Tha-final	442-454	prompted	1	Me: let's just quickly fast-forward here… there's a point where you come to look at his book Tha: mm, A____'s book Me: ya Tha: oh (watching) Me: /he's out of his chair, he's out of his desk again/ Tha: /oh, to check if he's doing ya… he's not here/ Me: ya, he's not here again (A____ is elsewhere in the classroom when Thandiswa comes to see him) (pause) Me: there he is! (pause) he's still working Tha: /oh/ Me: /but he's working/ you can see /he's working/ Tha: /he is working/ he is not playing, he is just helping them Me: he's moving around and he's being quite energetic in his work, neh? Tha: mm mm (agreeing)	Work can still occur when a student is moving around and talking with other students.	Thandiswa was in agreement that Anele, despite being out of his chair and moving around the room, was most certainly working and assisting other students.

T88	Tha-final	471-490	prompted	1	<Anele waited for the teacher to turn around and then did a little victory dance for the camera. This excerpt is just after his dance, which we both found very funny> Me: but, I mean (still both laughing at Anele) it's not a problem he's just very energetic Tha: (still laughing) and then I'm sure he got that (question) correctly… Me: yes! Tha: that's why he was… (laughs again) Me: yes! He's feeling … he's very confident Tha: mm hm (giggling) Me: sometimes I notice when another student makes a mistake, Anele is very quick to want to give the right answer Tha: ye-yes! Mm! Me: do you think that's a good thing? That maybe? Tha: ya, I think, I think it's a good thing Me: ok? A bit of competitiveness? Tha: if he, if he could be like that Me: mm Tha: always Me: ah ok, so he's not always so chipper huh? Tha: mm? Me: he's not always quite so energetic? Tha: mm hm (yes) Me: sometimes he's, uh, is he sometimes a little bit more quiet? Tha: more quiet yes, sometimes	The more confident a student is the better.	There doesn't seem to be a negative connotation attached to stronger students dominating or eclipsing weaker ones. This also manifested in the discussion about groupwork in Thandiswa's initial interview. See T42, T43, T45

T89	Tha-final	495-515	led	1	Me: Um, letting him move around the classroom and help the other students Tha: mm Me: it probably helps him? Tha: it helps him also Me: do you think it helps those other students who are weaker? Um, 'cos we were saying earlier students sometimes learn better from… Tha: from others Me: from other students Tha: mm Me: so there's a, there's a, a positive process there for both Tha: ya, there's a positive process there because they are able to interact with… Me: mm mm Tha: … each other Me: the stronger students explain Tha: mm Me: but the weaker students understand better? Tha: mm (agreeing) Me: so it's a, um, mutually beneficial Tha: mm ja Me: um… Tha: and also the one who's explaining will get better understanding Me: ja, ja, absolutely.	Students learn well from their peers	See T42, T43 and T45

T90	Tha-final	632-642	implicit	1	Tha: and I, I also brought mine Me: really? Tha: to class Me: ya, ya, I could've brought you mine as well Tha: mm hm Me: but they, they're so dependent on it when actually the, the numbers Tha: ya! Me: they could do without the calculator Tha: without calculators! Me: ya Tha: they are depending too much on calculators!	Part of what teachers do is make available what resources they can for their students in class. Also see T96	Thandiswa's response to the calculator shortage in the class was to bring in her own and lend it to the students.
T91	Tha-final	--	explicit	6	See T90	The students depend too heavily on calculators to do basic arithmetic.	Waiting for calculators was a significant time consumer in class.
T92	Tha-final	679-686	led	1	Me: Do you find that rate-of-work is a real problem? I mean, when you mark their tests how much of it is (that) they don't understand? And how much of it is (that) they never even tried the question because they ran out of time? Tha: ya! Me: is there quite a lot of that? Tha: That's quite a lot of that Me: mm so, you know, you don't even know if they understand or not, because they work too slowly Tha: because they didn't even attempt… Me: mm Tha: ..the question	Much student mark loss in tests is due to running out of time (student answer rate is too slow)	I saw a lot of this at my own school experience.

T93	Tha-final	688-692	explicit	1	Tha: and we always encourage them to start by those they know Me: ya! to read the paper first Tha: ya, read the paper first, then… Me: but then again, that also takes time? Tha: it takes time also!	Strategy is important to maximising marks in an exam	Comments like this expose where Thandiswa's priorities are for the students i.e. succeeding in the exam. Given the constraints, measures, incentives and criticisms around the high-stakes NSC exams, this is hardly surprising. What literature can be used here to discuss the phenomenon of teachers 'teaching to the test'?
T94	Tha-final	703-718	prompted	1	Me: You have, you, you laugh with the students Tha: (chuckles) Me: and you make jokes with them Tha: mm Me: how important is that relationship? Tha: (still chuckling) Me: between you and the students, to really good learning? Tha: ya… I think it does something in learning because they will be able to share with you… Me: mm Tha: …what they don't understand Me: ok… trust? Tha: ya… they won't be afraid of you! Me: ok… so it's /.impor…/ Tha: but sometimes they take advantage! Me: mm they… Tha: because they see you are nice (chuckles)	Students approach teachers they trust	

T95	Tha-final	--	implicit	1	See T94	'soft' teachers are taken advantage of	T69 and T70 express the common teachers' dilemma of balancing friendliness with respect
T96	Tha-final	595-604	implicit	0	Me: um … calculators! Tha: yoh! Me: oooh… /calculators/ Tha: /shame/ Me: I have a clip to show you Tha: they don't have calculators Me: they don't. How many, how many do you think have? A calculator? Tha: I'm sure, three! Me: three! In the whole class? Tha: in the whole class	the students struggle due to lack of resources	Thandiswa seems to feel sympathy for her students and their lack of resources
T97	Tha-final	643-654	explicit	6	Me: how could, how could we wean them off the calculators? To kind of save this time? Tha: I don't know Me: ya Tha: because they are struggling even to say 'eight plus five' Me: ya! Absolutely! Tha: 'eight plus five' they, they have to go to a calculator Me: …and it's actually slower /to use the calculator/ Tha: /mm mm/ (yes yes) it's slower! Me: so the rate of work Tha: they are really depending on the calculator Me: ya it's um… Tha: I'm sure from primary they are depending on calculators Me: mm…	Calculator dependence is developed in primary school	Like Zolani, Thandiswa recognises the calculators as a bottle-neck, although she doesn't blame the students for not having them. She also sees the dependency and the lack of adequate mental numeracy coming up from the primary school further feeding the need for calculators but is at a loss for how to address this issue.

T98	Tha-final	--	prompted	6	See T97	Using calculators for basic arithmetic slows the students rate-of-work down	Also see T90, T91 and T92
T99	Tha-final	517-537	explicit	4	Me: and then you were talking about putting the data in ascending order. And there was one sentence that came out as ‘arrange’ the data, and then ‘i-range’ Tha: mm Me: and I was wondering if the students find things like that confusing? Because they sound very very similar? Tha: mm Me: um “i-range” being a noun Tha: mm Me: it’s a concept and ‘arrange’ being a verb… Tha: mmhm Me: …which is something you do. Do, do you notice things like that in the classroom where words sound similar English, maybe English words? And the kids are like ‘huh?’ Tha: I think because there will be that word ‘ascending’ Me: mm ok Tha: it is mathematical—they have to know whether the sentence is ‘arrange in what way’ Me: ok Tha: the minute it’s ‘ascending’ they have to know… Me: ok Tha: … what they must do Me: so, it’s more, it’s more the ‘ascending’? Tha: ya! It’s more the ‘ascending’ Me: than the word ‘arrange’ Tha: mm (yes) Me: ok: that’s interesting.	Students should use contextual clues to decipher instructions and questions in their second language.	Unfortunately I don't think Thandiswa completely understood what I was trying to ask (although her answer was revealing nonetheless) which was that students might *confuse* the meanings of the two words when *learning* the words: if this were the case, contextual clues would not help. Contextual clues only work if the students have the correct L2 terminology in their minds already with the correct meaning attached.

Belief No.	Data source	Location	Belief type	Belief area	Transcription	Belief Statement [Prefix: "I believe that…"]	notes
Z1	Zol-Final1	0:35	prompted	0	Me: How much training did you receive on OBE when it was implemented? Zol: A week? Me: A week? Zol: About a week, maybe less. Me: ok, and then any support after that? Zol: No /no/ Me: /no../ Zol: no support Me: mm Zol: Mm, ah (remembering) a bit of support because we had workshops somewhere somehow Me: ok, but no one came to the school? Zol:, mm-mm (no), no one Me: watched you teach and then said 'try this try that' Zol: mm-mm (no) Me: ok, so there was no in-lesson support really…. um, do you think that that would've been useful if they had done that? Zol: Ja! It would be very useful! Me: ok	In-school support for new curricula etc. is useful/helpful (for implementing it)	It would've been interesting to probe the workshops further… I can't generalise this sentiment further than " in-school workshops would've been useful on OBE"…

Z2	Zol-Final1	1:20	implicit	1	Me: The first thing I wanted to ask was on Friday, there was a lesson that I wasn't in? (waited for a response form Zol: awkward pause) Me: I think I missed one because I was with Thandiswa Zol: mm… what happened then on Friday? (trying to remember) (pause) Me: mm, they were doing the trig ratios from Cartesian coordinates on Thursday Zol: ohhh! uh-uh, we break early Me: on a Friday? Zol: on, on… I didn't have a period.	Contact time is not sacrosanct. [also see the revised observation schedule for further evidence of this belief]	Or perhaps Z knows that it is NOT allowable, hence her excuse. But her explanation doesn't make sense, as I had a lesson in P3 on the Friday with Thandiswa => there was a lesson at that time, and school was in session. I saw regularly that on Friday the school was closed early (not reflected on the timetable). Although this belief was never espoused, it was strongly reflected in repeated behaviour.
Z3.1	Zol-Final1		explicit	0	Me: Do you think the recording with the camera has changed the children at all? Have they been different, because they've been recorded? Zol: Ja, they've been a little bit tense Me: Tense? Zol: Mm, mm (yes) Me: sometimes I catch them looking at the camera Zol: ja, they're a little bit tense but (pauses) they are not usually active also. Me: ok Zol: mm, mm but the camera ke, I think they were shy. Me: They were shy Zol: mm (yes)	Students' behaviour was 'tense' compared to normal	This statement was countered with the caveat that the behaviour of the students didn't differ much in terms of activity levels. Also states that Zol did not think the students "active" in the lessons I observed. Does 'active' in this sense mean the opposite of 'passive'? Or 'lively'?
Z3.2	Zol-Final1		explicit	-	See Z3.1	These students are not particularly lively generally.	

Z4	Zol-Final1	2:19	explicit	0	Me: ok… um, how did you feel, being recorded? Zol: (pauses) mm, a little bit nervous Me: mm… Zol: because when you are alone, you're relaxed, ne? Me: mm Zol: Mmm you can say whatever you want to say to them Me: mm Zol: now there's somebody looking so you cannot shout at them now Me: mm, you felt like you couldn't really discipline too strongly? Zol: mm! (yes!) Me: ok, fair /enough/ Zol: /because/ sometimes they _need_ /strong/ discipline, also Me: mm, ok	It is not desirable that the mechanisms that can be employed to discipline students should be witnessed	Serious ethics concern here--that what is done when observed is not what is done when left alone with the children. This further alludes to the other beliefs expressed that are very deficit and derogatory towards the students. In particular, this belief could be interpreted to mean that the students are 'less' and don't warrant respect.
Z5.1	Zol-Final1	2:31	explicit	0	See Z4	Sanctions/punative measures are important to being an effective teacher	

Z5.2	Zol-Final1		explicit	0	See Z4	These students in particular are in need of strong discipline	

Z6	Zol-Final1	3:08	implicit	1	Me: Um, the seating in the class--did you put the students like that or did they /sort themselves out/ Zol: /we put/ them. Me: you put them like that. Zol: mm (yes) Me: is there a reason why it's mostly boys only or girls only Zol: (laughs) we put them…. they they they arrange themselves and then we saw that it's ok Me: ok… but if there's… Zol: we approve Me: any trouble, you… ah ok move them, and you've, I've noticed you also put them in groups and not in rows. Is there a reason you chose groups like that? Zol: Ja! We encourage group working so that they can assist each other Me: ok Zol: when there is a problem… we tried to put at least one learner who is a little bit understanding in one group Me: ok, a stronger, a stronger learner per group? Zol: mm	Students should be allowed to assist each other in their work	this further enforces some of the other beliefs expressed about students learning effectively from each other.
Z7	Zol-Final1	3:08	explicit	1	See Z6	Being seated in groups in the classroom is conducive to students helping each other	
Z8	Zol-Final1	3:08	implicit	1	See Z6	"Groupwork" is about peer support rather than task design.	This is a useful example of what Speer is referring to when she means words mean different things to different people.
Z9.1	Zol-Final1	3:16	explicit	1	See Z6	differentiated abilities help in 'groupwork' where stronger students can support weaker students	

Z9.2	Zol-Final1		implicit	1	See Z6	Stronger students should support weaker students	By giving this reasoning for arranging the seating in this way, Zolani is effectively saying that stronger students should be helping their peers (i.e. that there is an expectation that they help)
Z125.1	Zol-Final1	4:36	implicit	1	Me: we've got the girls at the back here... (pointing to video) Zol: mm Me: these four girls, actually five girls here Zol: mm Me: they seem to be... not as engaged as maybe the girls at the front Zol: ja Me: do you have... tell me, tell me about these girls. Are they struggling? Are they... Zol: they are struggling Me: they are struggling? Zol: because they are repeaters Me: they are repeaters? Zol: mmhm (yes) but these two (pointing at the screen) Me: mm? Zol: at least they've, mm, they understand but they...they are having problems as the year goes on Me: ok Zol: I, I, I don't know why Me: ok Zol: 'cos at least they are better at maths Me: mm Zol: They're all repeaters Me: mm, ok, are they quite diligent? Zol: (pauses)... uh-ah... (doesn't want to comment) Me: ah, you can't say Zol: uh-uh	There is information that should not be shared with a researcher, even anonymously.	Not sure what to make of Zolani's reluctance to answer here: there could be multiple interpretations or ideas : perhaps Zolani has ethical/professional concerns about sharing her subjective judgment of specific students : perhaps she has misunderstood the question (the word 'diligent' may have thrown her) : perhaps she feels that her opinion of these students is socially unacceptable
Z125.2	Zol-Final1		explicit	1	SEE Z125.1	Students who repeat a year can still struggle with that year's work	

Z125.3	Zol-Final1		implicit	0	SEE Z125.1	It's acceptable to hold students back under specific circumstances	What are these circumstances? How does this relate to policy at national and school-level?
~~Z125.4~~	~~Zol-Final1~~		~~implicit~~	~~1~~	~~SEE Z125.1~~	~~Repeaters do not get specific support/differentiated learning~~	This was not actually espoused but rather drawn from the observations.
Z10	Zol-Final1	4:50	explicit	1	Me: and the next... so here's the girls at the back Zol: mm Me: (pans the video around) and then we've got this table of boys Zol: mm Me: and they often look like they are /completely/ lost Zol: (chuckles) Me: they often look at each other and go 'huh?' Zol: (chuckles) they are lazy! Me: they're lazy? Zol: mm-hm (yes)	Students' lack of understanding is attributable primarily to their work ethic	this belief recurrs frequently [strong central belief!]
Z11	Zol-Final1	5:47	explicit	1	Me: and then we've got the girls who sit in the front middle, and they seem to work quite hard... (waiting for the video to pan around) this table of girls... they seems to work quite hard Zol: mm Me: up front Zol: ja (pause) uyabon' and they lastly they are... they are losing it (gets exasperated) I, I, I don't know man what is happening to these children you know, because these children! One day they are strong the other they completely don't understand	the source of the students' lack of attainment is unfathomable	Zolani expresses much more sincerely here that she is struggling to understand what is happening in her classroom. What could this be attributable to? Zolani seems to be struggling for the language or knowledge to describe or diagnose accurately what is happening in her classroom. She seems at a loss to explain what is happening...

Z12	Zol-Final1	6:19	explicit	1	Me: and this table of girls as well also seem to work quite hard (points at a particular student) this is the girl who does her homework Zol: ja! Me: and she seems to be (indicates sharp by clicking fingers) Zol: but the, the strongest is this one (points at a different student) Me: ok! This lady up front here? Zol: ja, this one (points at the student who did her homework) is talkative Me: ok Zol: can talk, but this one is very good Me: ok	Being talkative can interfere with learning	Not sure I can infert his as a general rule from this data: can at least infer that student A is NOT the strongest because she is talkative. Local, not global.
Z13.1	Zol-Final1	6:40	explicit	6	Me: and then, at the back, we've got that group of girls and we've got these boys (indicates the table in the foreground) Zol: (seeing the boys) wa ke! ooh, these ones are *clueless* maybe they said that "we don't like mathematics" Me: mm Zol: these ones Me: none of them, none of the students surprisingly said they don't like it. They all said no we like it and we think it's very important Zol: ooh? Me: Don't you think it's weird? Zol: (laughing) ja, it's weird! Me: ja, they all said "ewe kubalukile! Zol: mm mm Me: "Zibalukile izibalo" Zol: but they are not taking it seriously. Me: mm	Students' responses about how they view mathematics do not match how they behave	Zolani seems surprised the students said that they like mathematics. Zolani finds it strange that the students reports do not match her assessment of them. Nonetheless she makes it clear that she trusts the students' enacted beliefs over their espoused beliefs. Their behaviour is her preferred source of information over their responses. 2 possible explanations: 1) Experience has taught Zolani that talk is cheap. 2) Their behaviour matches her existing judgment of them, so she'd rather believe this as it does not require her to revise her opinion.

Z13.2	Zol-Final1		implicit	0	See Z13.1	Behaviour is a better indicator of real beliefs/ a more trustworthy source of information than words	
Z14	Zol-Final1		led	0	Me: and there's a couple of kids in the class as well who are a bit older Zol: mm (yes) Me: do you think that makes a big difference? Zol: Ja, the older they get the more…	Older students struggle more with their learning.	The discussion particularly focused around mothers in the classroom. However, this was not separated out from the phenomenon of repeating a year or skipping a year, both of which could more plausibly affect a student's self-efficacy or learning continuity i.e. age is a proxy for these other problems too.
Z15	Zol-Final1	8:05	prompted	6	Me: very interesting… um… and the boys and the girls, do you see much difference? Between the performance, or is it all the kind of same? Zol: hayi, the girls are better than boys Me: ok, Zol: girls are better than boys Me: mm, why do you think that is? Zol: mm? Me: why do you think that is? Zol: hayi, the boys are very lazy… they are smoking Me: ok Zol: mm (yes) Me: just cigarettes or other things /as well?/ Zol: /mm, and they/ are influencing each other. They are not serious man! Yoh! Me: mm Zol: they are not taking school seriously Me: mm mm..	Girls are better than boys at mathematics (due to more diligent application rather than innate ability)	
Z16	Zol-Final1	8:19	explicit	0	See Z15	The girls in grade 10 work harder than the boys	

Z17	Zol-Final1	8:19	explicit	0	See Z15	Smoking (dagga) makes the students lazy	I didn't get confirmation directly from Zolani about whether the boys were smoking dagga or cigarettes, but the interview with MB refers to smoking of marijuana.
Z18	Zol-Final1	8:25	explicit	0	See Z15	Negative peer pressure is more prevalent among boys...	

Z19	Zol-Final1	9:40	prompted	6	Me: mm mm.. (pause) another interesting thing that I noticed a lot was um the …we spoke a little bit in your initial interview about calculators: they are _very_ dependent on their calculators! Zol: mm! Me: I saw this in your class and in Thandiswa's, to the point where… let me look for the clip quickly here… "calculators" … two, thirty-nine, five… where they, um, if they don't… if they forget their calculator or they lose it or they don't have it Zol: mm? Me: they can't work! Have you noticed that? Zol: mm-mm! (yes) I know! Me: and, I mean, a calculator is what: R50… R60, so it's not a cheap thing Zol: mm Me: Especially if you… a lot of the children were saying "no we're um… I live with my mom, she's on a grant, or I live with my gran, she's on a grant… um… <to myself> thirty-nine-oh-five…so fifty-sixty rand's not an insignificant amount of money… Zol: mm Me: um, how do you think you might be able to… /is/ there a way we could /wean/ them off the calculators because (.) they can't afford 'em or they lose them and when they don't have them they can't work Zol: hayi, not now! Me: too late? Zol: it's too late Me: ok Zol: they are _very_ dependent on them…	There's no way of weaning the students off their calculators at this late stage	My original question: "Is there a way that we could wean them off the calculators because they can't afford 'em, or they lose them, and then when they don't have them they can't work". Later Zolani says that the issue of calculator dependency comes up from primary school.
Z20	Zol-Final1	10:45	led	3	Me: but often … look at the table… out with the calculator! Zol: mm-hm (aha!) ja, because there are questions uthi (that say) 'without using a calculator' ! Me: but they've kind of started to associated maths … Zol: mm (yes) Me: … with a calculator.	maths is often associated with calculators at the school level	this is my stating something and Zolani agreeing.

Z21	Zol-Final1	12:10	explicit	0	Zol: and you you know, we tried! The department has offered us calculators Me: oh ya? Zol: for grade twelves! Me: ok Zol: last year every…I, I had thirteen grade twelves and thirteen calculators. I, I, I gave them this year Me: mm Zol: I've got ten (students)… everybody has got a calculator Me: mm Zol: in January. If you can go there there're only three calculators Me: they've lost them? Zol: they've lost them Me: mm Zol: mm Me: what if you, what if you… you kept them? And only gave them to them in class? But then I suppose homework's a problem Zol: I, I, I didn't know that they would do it…they'd lose them, ne? I wanted them to practice because they are grade twelves Me: mm, mm, ja, ja Zol: ja, I, I, I took them as adults, responsible adults so I gave them calculators… now I want to use calculators in class? No calculators.	the students are not responsible with their belongings	This is an understandable belief based on Zolani's experience of handing out calculators. Perhaps this incident is one of many that have fed her deficit model of the students in general. She is obviously very disappointed. This particular issue speaks to the broader tension between quantity and quality of learning and the creation of efficient and unconstrained contact time. The lack of calculators coupled with the dependency on them is compounding the indirect loss of contact time on top of the actual direct loss of lessons.

Z22	Zol-Final1	12:30	prompted	7	Me: another thing that's interesting, and I think it could be useful for students doing homework at home… Zol: mm mm Me: …again the cost is an issue but then it's also not something you want to lose… is a dictionary! Zol: mmm Me: um, I've got some here that I've been gathering (moves to get her dictionaries from the bag) and collecting so there's…. there's the normal dictionaries, right, there's like English-Xhosa, Xhosa-English Zol: mm Me: but then you look at the work for example like 'opposite' in this dictionary (referring to the standard bilingual dictionary) and there's _nothing_ about mathematics /at all/ Zol: /mm mm/ (yes!) Me: /it says/ um 'isichasi'… so you know 'chasa' is a /different type of opposite …/ Zol: /that that/ is why I said 'there's no need' Me: ya Zol: as such for a dictionary Me: for a dictionary Zol: because… Me: and a maths specific dictionary? Would that be of any use? Something like this? (shows Zol a maths-specific bilingual dictionary) Zol: Ja ke! (yes!) this one! Me: mm Zol: a maths dictionary! Me: this one…mm, let me show you here (turns to a marked page in the book) they give 'opposite' Zol: mm	standard dictionaries are not useful in the maths classroom	
Z23	Zol-Final1	13:30	prompted	7	See Z22	maths words are specific to the discipline	The discussion arose about a specific mathematics dictionary. Note: it is important to distinguish that although this belief about mathematics works is not *about* teaching and learning directly, it has implications for T&L.

Z24.1	Zol-Final1	13:50	prompted	1	Me: but then, um, they can't have a dictionary in the exam? Zol: mm Me: so maybe it's not a good thing? Zol: ja… (pause) but if they are used to it or if they are using it at home at least during exams they will be… Me: they'll know the words? Zol: mm (yes) Me: so you think there's more a place for a subject-specific dictionary Zol: yes Me: ja	Any risk of dictionaries creating a dependency is outweighed by the benefits of increased L2 mathematics vocab.	I threw up the problem of dictionaries not being available in the exam. Zolani seemed to think that this did not counter the potential benefit that a maths-specific dictionary might have in developing students' understanding if used at home.
Z24.2	Zol-Final1	n/a	prompted	7	See Z24.1	Specific maths bilingual dictionaries would assist learning in the classroom.	There is a productive space/role ofr mathematics-specific bilingual dictionaries in maths class
Z25	Zol-Final1	15:52	prompted	7	Me: but then you know sort of… you can say 'ukuthabatha', 'ukudibanisa', 'ukusahluka'.. but, but do the children actually know these words at home? Zol: mm, they know! Me: they do know them? Zol: they know, they know mmm Me: ok, so it's not um… Zol: it's not some strange words Me: mm ok	the children do know the basic words for arithmetic operations in isiXhosa	

Z26.1	Zol-Final1	16:15	prompted	1	Me: So many times you say for them… Zol: "any questions" Me: "any questions?" and then *cwaka*… why do you think that is? Zol: ey! they are not confident Me: ok Zol: mm, they aren't confident. They are not sure whether maybe the questions will be relevant or irrelevant Me: ok… Zol: they are not confident about themselves… Me: mm Zol: …a little bit shy, so really if you don't understand you don't know where maybe this question will be a stupid question… Me: mm Zol: …maybe others understand this question so mna I will just be asking a very obvious question so /rather keep quiet/ Me: /mm/ ok… you think they, they … Zol: and, and they are not serious man they are laughing at each other! Me: ok! Zol: /that's/ the other problem Me: ok… Zol: mmm Me: so there's, there's a bit of… shaming? going on if you do make a mistake? Zol: ja! Me: .. there's no space… Zol: there's no space Me: …/to make/ mistakes	students lack confidence to ask questions in class	"so many times you ask them 'any questions'.. And they don't answer. Why do you think that is?" Zolani does not seem to spot the contradiction between the students being shy to ask questions and the 'strong discipline' + response they get if they ask a question that she feels they should already know the answer to (See Zol 2)

Z26.2	Zol-Final1		explicit	1	See Z26.1	Students lack a sense of what constitutes a relevant question in class	
Z26.3	Zol-Final1		explicit	1	See Z26.1	Students believe some questions are stupid	
Z27	Zol-Final1	16:34	explicit	1	See Z26.1	students fear feeling 'stupid' in front of their peers	Zolani recognizes quite empathetically what might prompt students to not ask. This contrasts so strongly with her description of students as lazy or 'not dedicated'.

Z28	Zol-Final1	16:49	explicit	1	See Z26.1	students put each other down through mocking each other's errors.	Zolani in the next breath describes perhaps in more detail what she means by 'they are not serious' by describing the form of public 'shaming' that students inflict on each other with derisive laughter at mistakes (also saw this quite cruelly in grade 8). This is not uncommon amongst teenagers where peer-judgment is of paramount importance to identity and social standing (? need to find some research to back this statement up). Could've been interesting to ask Zolani what her role is as a teacher *outside* of mathematics in developing students to interact in kind and constructive ways together as a group i.e. personal/social development

Z29	Zol-Final1	17:45	led	1	Me: (repeating the video for audibility) "finding the third side, Grade 9 work" *Zol-video: "At least they've got an idea"* Zol: mmm *Zol-video: "but xa ndine-two sides, we are given two sides of a triangle, ndifuna i-third side" uthi uzoqala .. he has an idea, just a faint idea"* [18:00] <stops video> Me: mm, so there you've taken their offering and you said 'ya, they've got an idea!" Zol: mm! Me: "let's build on that" Zol: mm Me: um, and do you think that that makes the student feel...? so they didn't give you the right answer Zol: yeah Me: but they're not being told *wrrronnnnggg* Zol: 'wrong' [18:15] Me: you're kinda taking that answer and building it: do you think that helps? Zol: yes, it helps Me: ...with the /confidence issue/ Zol: /with their confidence/ mm Me: mm-hm (affirmatory) Zol: not to say 'wrong, wrong, wrong' at least you've.. they've got that idea Me: mm mm Zol: /you can use it/ Me: /a little/ bit of a hint.	taking a student's offering and building on it instead of dismissing it helps to build confidence	Zolani explicitly expresses the understanding that saying 'wrong, wrong wrong' can undermine a student's confidence. Perhaps this explains somewhat the vigniette from Zol1 where she is reluctant to provide 'evaluation' because the students' offerings are wrong?

Z30	Zol-Final1	18:40	prompted	1	Me: what else can be done to help build their confidence? Zol: (pause) mm, ey... Me: it's a difficult question Zol: /it's a difficult one/ Me: (laughing) I'm asking you a difficult question Zol: (chuckling) Me: what do we do to build their confidence? Zol: maybe to praise, just to praise them Me: ok? Zol: mm Me: praise. Zol: mm mm Me: to tell them 'ya, you're doing well' Zol: mm	praise builds students' confidence	contrast this with videos! How many instances of praise are there in the observations? What were students praised for?

Z31.1	Zol-Final1	20:15	prompted	1	Me: would you ever give them, like, the a-a a marksheet and say 'well, when you've finished Zol: ya!! Me: … mark yourselves Zol: I usually do that Me: ok Zol: ya, mark yourselves and I, I usually give them extra work Me: ok Zol: while I'm busy with the others Me: ok… and, are, are there any down sides to giving them a marksheet? Can it cause problems at all? Zol: mm-mm hayi, no problems as such because a, at least I give those uyabo' who are fast Me: oh, ok so it's not to everybody, just to those who are Zol: mm (yes)	using a memo to mark their own work is an effective learning technique	the memo-marking mechanism is only used for those students who work quickly
Z31.2	Zol-Final1		implicit	1	See Z31.1	Extra work is a mechanism of differentiation	Differentiation seems to be more about more work at the same level rather than more difficult work, but this is an assumption (don't have hard evidence of this).
Z32	Zol-Final1	20:40	prompted	0	Me: Do… do they copy at all? Zol: they copy each others work. Me: why do you think they do that? why are they copying? Zol: lazy kaloku! Me: lazy? Zol: just lazy! just like they don't have time Me: ok… they just want, they just want to show you the right /marks in the book/ Zol: ewe, ewe! Even if they are not right, just to show that 'I've done it'! Doing it for the sake of doing it, so they just copy. Me: ok. Just to kind of meet the expectation and… Zol: mm (yes) Me: … with as little effort as possible. Zol: mm (yes) ya!	students copy each other's work because they are lazy	

Z33	Zol-Final1	21:00	explicit	1	See Z32	students copy work to demonstrate the desired outcomes with minimal effort	Zolani observes that sometimes students copy just to show that it's "done"--this could either be because a) not completing the work is a barrier to something desirable e.g. leaving! Or b) because completing the work pleases the teacher and the students want to please? need more information than is available to discern *why* students might do this. Zolani agrees that it is to 'meet the expectation with as little effort as possible'

Z34	Zol-Final1	21:25	explicit	0	Me: 'cos I saw some copying and I thought 'well, that really kind of doesn't... ' Zol: they are copying, you've noticed that they've not done the homework which was given on Thursday Me: mm Zol: on Monday, I want that homework, most of them have not done it Me: mm Zol:... because they are not doing it at home Me: mm Zol: ...so, they are not after their work, so it's just school: at school... after that, no books at all Me: /no books at all/ Zol: ja Me: and if they, if they've tried the homework but they just are /clueless/ Zol: ja Me: then...? Zol: hayi, they were not just that bad they were not clueless Me: no? Zol: if they'd tried that homework at least they'd have done something Me: something ... Zol: and they would be able to as-ask questions that "I've done this"... Me: mm Zol: where did I go wrong?" Me: ok Zol: uyabon'? Me: ya Zol: but because they are not doing anything so they	students are not working at home	the copying in the particular instance Zolani is referring to is students copying homework in order to 'not get caught' (and, ostensibly, face sanctions which are, as Zolani has alluded, often quite 'strong'). Lack of conductive home environments is a known problem in poor areas--find some substantiation for this (Fleisch) BUT Zolani attributes it to laziness... is this perhaps because she feels her own circumstances were similar yet she managed to overcome? She does infer that "things were different in her day" but more in reference to students' attitude and discipline rather than socio-economic circumstances. Would be interesting to try and briefly compare: what *are* the socio-economic circumstances of old homeland areas between the two eras?

Z35	Zol-Final1	21:40	explicit	0	See Z34	absence of homework is due to non-effort, not absence of understanding	This is not an uncommon issue as a teacher where a failed attempt at homework can only be distinguished from no attempt at all by some evidence of trying. It is often conflated with students' confidence and concerns of appearing 'stupid'--they do not try for fear of showing how little they understand (and this is leveraged by students who genuinely make no effort). However, the boys up front expressed explicitly how they _had_ tried the homework, and certainly had filled in the forms I'd sent home with them (they were amongst the few who did). Zolani confirms (when prompted) that books are the evidence she uses to distinguish between no attempt and a failed attempt at work (see journal).
Z36	Zol-Final1	21:45	explicit	1	see Z34	Being able to ask questions is evidence of having attempted work	Zolani is assuming a basic level of understanding here that is not premised on some kind of assessment to verify its presence (*that I witnessed*).
Z37	Zol-Final1	22:30	prompted	1	Me: You...do you use the children's books quite a lot to show you where /they're really at?/ Zol: ja, I, I do that Me: mm Zol: most of the time like, if I did... I-I-I've given them homework, I look at their books before I mark them I look...	the students' books are a good body of evidence for their understanding	This is particularly interesting given the absence of Zolani questioning in class. Most of the small group discussions I saw were Zolani explaning and students asking, not the other way around.

Z38.1	Zol-Final1	22:45	prompted	1	Me: I noticed you do move around the classroom a lot and when the the students are more in an intimate setting… Zol: mm Me: just you and maybe four of them they ask a lot more questions huh? Zol: mm mm (yes) Me: is that… why do you think that is? Zol: I… it's it's helping they just want… they don't want to be heard by others, ok, so they just want to ask me that… I said mos they don't want to seem stupid Me: mm Zol: … like they are asking simple questions by their colleagues Me: mm Zol: so at least if I am with them they can ask questions Me: ok, right. And as you say, it's less of an audience Zol: mm (yes)	helping students one-on-one or in smaller groups results in more productive discussion	Also noticed that students discuss and ask more in isiXhosa when engaging with the teacher in smaller groups or one-on-one. Could the increased engagement be due to a greater linguistic resource pool to draw on, rather than the absence of audience?

Z38.2	Zol-Final1		explicit	0	See Z38.1	students are more confident to speak in smaller groups where there is less of an audience	
Z39	Zol-Final1	23:20	prompted	6	Me: I remember when I was in maths class at school, and my teacher brought one of these (holds up a Rubik's cube) to class, and I was hooked. This is just the coolest thing Zol: yes! Me: do you think that it's good to use something like that Zol: ja! it's very good! Me: ya, if you can? 'cos it's not really... Zol: Ewe!! Me: directly in the book... Zol: but if you can solve it at least... (she is very enthusiastic about the cube)	visual/tactile puzzles can stimulate an interest in mathematics as a subject	This discussion revolved around the Rubiks cube that I brought to the interview. Zolani was quite strongly of the opinion that, despite such things not being in the syllabus, tools such as a Rubik's cube or other problems could get students excited about mathematics.

Z40	Zol-Final2	0:20	explicit	7	Me: have you noticed that the amount of Xhosa has increased? Zol: mm (yes) Me: why do you think that is? Zol: (chuckling) I I just wanted them to understand, I just wanted them to understand, ya Me: ...and... Zol: ... to feel free, relaxed, talk with their own language	using isiXhosa helps the students to understand in mathematics lessons	The original prompt was whether Zolani had noticed the amount of isiXhosa increasing throughout the 4 lessons I observed her. She independently offered the response that the students would 'understand' more if she used isiXhosa.
Z41	Zol-Final2	0:40	explicit	4	See Z40	students feel more relaxed and able to communicate about their learning in isiXhosa	Zolani recognizes how limiting operating in English is for the children, and how much more free they are to communicate in isiXhosa
Z42	Zol-Final2	1:00	prompted	1	Me: Um, and when you're walking around the classroom, I'm assuming that that is a... a deliberate thing you're doing to... is it to make sure they're doing their work? Zol: mm? Me: or is it to make them feel like the support is close by? Zol: ja... both! Me: both? Zol: mm (yes) Me: a little bit of everything? Zol: mm (yes) Me: um... Zol: you must make sure that they are doing their work and they must know that I'm I'm there to give support whenever they need it	moving around the room can assure students that support is near (supportive)	

Z43	Zol-Final2	1:00	prompted	1	See Z43	moving around the room can deter students from getting distracted for fear of detection (punitive)	
Z44	Zol-Final2	1:00	implicit	1	See Z43	teachers can concurrently play both supportive and punative roles towards their students	

Z45.1	Zol-Final2	4:30	led	1	*I show Zolani a vignette from the observation videos where she leaves the class temporarily...* Me: so you can see that, uh, there's not a lot of noise Zol: mm Me: I was quite impressed actually? Zol: hayi, they are not that noisy, these Me: mm Zol: mm, they are not that noisy this class Me: 'cos, ah, when I was, when I was at school, if the teacher left the room Zol: mm? Me: yo! the boys were out their seats! Zol: and they start! (chuckling) Me: yeah! so they were.. Zol: hay, at least these... otherwise, others, yo! they'd be up Me: really? so this class you think is particularly well behaved? Zol: ya, and ke because there was a ... a video Me: ok, so they thought 'we'd better behave ourselves'. D'you think that if there wasn't a video there might have been a bit more? Zol: at least they would be not that serious! (chuckling) Me: (giggling) Zol: not that serious but they are not that noisy because they are next to the staffroom Me: ahh! Zol: uyabon'? (you see?) Me: aha! Zol: at least they know that I'm just next door	students behave when being watched	"serious" to Zolani seems to be her keyword for describing a good work ethic, or focused attention to learning. Is it the threat of punishment that makes students behave?
Z45.2	Zol-Final2		implicit	0	See Z45.1	Being 'well behaved' and being focused on learning are not the same thing.	

Z46	Zol-Final2	4:30	prompted	0	See Z45.1	the grade 10 class is not particularly noisy	Zolani seems to think (with good reason) that there are constraints affecting the behaviour decisions of the students. Even so, it would seem them that the threat of punishment is a severe disincentive (compared to, say, the UK where threats of punishment are often ignored).
Z47	Zol-Likert	n/a	prompted	7	mild disagree	1. Students should use dictionaries in class to help them with their work	See Z22-Z24
Z48	Zol-Likert	n/a	prompted	1	mild agree	2. As a teacher, I feel I have a strong influence on the lives of my students	
Z49	Zol-Likert	n/a	prompted	6	strong agree	3. Some students just won't ever really get maths	This implies that mathematics learning has a strong essentialistic quality. It also provides a convenient explanation for failing students.
Z50	Zol-Likert	n/a	prompted	1	mild agree	4. Students learn more when taught by the teacher than when taught by each other	Zolani maintained her position as the dominant/superior source of knowledge in the room, while agreeing that some benefit could be gained from peer learning.

Z51	Zol-Likert	n/a	prompted	4	mild agree	5. The burden on English teachers is greater than others because they provide students with the language they need to learn	See Z83-Z84. Does Zolani see language acquisition as her burden/responsibility. The evidence suggests she does not.
Z52	Zol-Likert	n/a	prompted	7	strong disagree	6. Talking about maths (in any language) is no different to talking about other subjects at school	Zolani recognises the specificity of mathematics talk/discourse.
Z53	Zol-Likert	n/a	prompted	3	mild disagree	7. There is usually only one way to solve a particular type of maths problem	This belief is interesting as it belies Zolani's procedural approach BUT it is useful to keep in mind that some mathematics problems have multiple procedural solutions. E.g. given 2 sides and an angle in a right-angled triangle, trigonometry or Pythagoras' theorem could be used to solve the question.
Z54	Zol-Likert	n/a	prompted	4	mild agree	8. A student can use a language for learning without being able to *speak* it.	This statement seems crazy!? Need to refer to some literature when discussing this about L2 comprehension versus L2 production.
Z55	Zol-Likert	n/a	prompted	6	mild disagree	9. Students don't really *need* to learn any maths that is not covered by the school curriculum	This belief statement presents an interesting insight into Zolani's view of mathematics as a subject and its social role. The distinction between *needing* to learn mathematics beyond the curriculum vs. *benefitting from* learning mathematics beyond the curriculum is subtle but important. For my own position, I'd argue that advanced mathematics is *over* valued in terms of its perceived necessity and usefulness to the average person. That they could *benefit* from it is a different question entirely.

Z56	Zol-Likert	n/a	prompted	6	mild agree	10. Learner-centred approachs (like OBE) work well for teaching mathematics	would've been great to have more time to explore the idea behind OBE/learner-centred pedagogy and why maths is suited to it. #lackoftime (this is not particularly useful actually)
~~Z57~~	~~Zol-Initial~~	~~16~~	~~explicit~~	~~6~~	~~Me: Really?~~ ~~Zol: oh, very dedicated, and always motivate us but knew we'd get us somewhere with this maths so I enjoyed… I enjoyed working with her very much…~~ ~~Me: inspirational?~~ ~~Zol: so… ja, inspired me a lot. And then, at college, I decided 'oh, I want to be like her'. So I'll do it. I want to be a teacher, to be like her, so I decided to take mathematics.~~	~~Dedicated maths teachers are inspirational~~	This expression is affective: Zolani is expressing her enjoyment of her own maths learning experience. Perhaps this is why she cannot realte to/understand her students' experiences? NOT AN ESPOUSED BELIEF. MOVED TO "points of interest"
Z58.1	Zol-Initial	28	implicit	1	Me: Ok. Was there a lot of… was there a lot of disruption in your maths learning in high school? There was a… with a lot of upheaval at the time? Zol: No… Me: No? Zol: …not as such, and we were very dedicated learners that group of us Me: disciplined Zol: ja, we were very disciplined	Dedicated students do not let distractions get in the way	
Z58.2			implicit	6	see Z58.1	A person's enjoyment of mathematics does not necessarily correlate with their attained grade in the subject.	Zolani spoke of her own maths learning and maths teacher fondly (her enjoyment being such that she chose a career as a mathematics teacher!) yet she only scored a D grade in mathematics in her senior assessment (50-59%).

Z59	Zol-Initial	50	explicit	4	Me: um, when she was teaching you, you wrote English exams like you still do now? Zol: Mmhm! (yes) Me: um, but was most of your class isiXhosa speaking? Zol: isiXhosa, yes Me: and she spoke isiXhosa as well? Zol: ja, spoke isiXhosa somewhat, somehow Me: ok, so you'd code-switch a lot in class? Zol: ja…but man, that time, we understood Me: mm! Zol: we understood, yo, for real Me: and the code switching didn't get in the way? Zol: mmhm, and we… we were not bad at English also	neither code-switching nor learning in English are a barrier to understanding	Zolani views her English learning at school to have been sufficient for her learning purposes (See Z54)
Z60	Zol-Initial	50	implicit	0	See Z59	the students in current times do not understand	
Z61	Zol-Initial	54-56	implicit	4	Zol: mmhm, and we… we were not bad at English also Me: ah, ok: you had a good English teacher at school? Zol: We had a good English teacher, ja	having a good English teacher assists you to be good at English	See Z51
Z62	Zol-Initial	98	explicit	0	Zol: It's (her old training college) a police offices now Me: Oh really? Did they close it down? Zol: Ya, they closed it down. Me: Ja, they closed a lot of the teaching colleges down huh? Zol: Mm Me: How do you feel about that? Zol: Hayi, mm-mm, it's… it's sad. It's sad because you're getting few teachers who were trained (as) teachers, so I think, it's not good. Me: Mmm Zol: It's not good at all	there is a shortage of teachers due to the closing of the teacher training colleges	

Z63	Zol-Initial	102	explicit	0	Me: You feel your college prepared you well? Zol: Mmhm, ja, it was good… good training Me: Good training Zol: …because, if you go to the university neh, you are prepared for… for other fields and then you take one year if you decide to do teaching, uyabon', it's only one year for teaching Me: that's right, it's the PGCE Zol: Mmhm (yes)	the teacher training colleges prepared teachers well	
Z64	Zol-Initial	104	implicit	0	See Z64	the PGCE route is not as good as doing a full teaching qualification	Quantity of training is what matters: this is an interesting reflectin of the phenomenon I observed generally in the village re. age. Age is perceived to be correlated with knowledge, since more years implies more time to accumulate knowledge. The quality and rate of learning during this time is not taken into consideration. Also, by virtue of having received a teritary education, PGCE candidates obtained a university exemption in their senior certificate results. This was not necessarily the case for teacher training colleges?

Z65	Zol-Initial	122	implicit	0	Me: right—that's good. That's really really good. Um, and you said that you found maths really kind of inspiring at school Zol: Oooh, I, I, I loved it! Even at college, Me: do you still /love it…?/ Zol: /even, even/ when I started teaching, I loved it, I loved it very much. I… ooh, these… these kids …. (pause) I don't love it the way I used to. Me: Mmm… you feel like they are sapping your energy? Zol: Ey, ah-ah. Man, they… (very sorrowfully)… they are letting me down. You know? Me: Mm Zol: They, they are spoiling my credentials. You know? I used to have good results! Me: Right Zol: But now I, I don't know. Every year it is deteriorating instead of going up Me: mm, up? Zol: Ya!	poor results affect a teacher's confidence	Zolani statement "ooh I loved it" is clearly affective. Why does she use the word 'even'?
Z66	Zol-Initial	124	explicit	1	See Z65	students' poor results undermine their teachers' careers	

Z67	Zol-Initial	140	implicit	0	Me: Where were you teaching before Geju? Zol: Ah, I started here! Me: Oh, you started here? Zol: I started here Me: Ah ok, and then.., ey, so you've been here for all the time? Zol: All the time. Me: Wow! Every day from Qoboqobo?! (draws in breath) Zol: Every day from Qoboqobo to here, I've been here. Me: That's a long time Ma Zol: I u..I used to love… because I love mathematics neh! Most of the teachers didn't want to come to the rural areas. Me: That's right Zol: And I said 'yhu, I want to teach them! I want the rural kids to have this information.' Me: Mmm Zol: I was confident then! I was new, with no experience but… just the love. But now, I'm experienced.	teachers' love for their job is not innate--it is affected by the degree of success they experience in their work	Here Zolani distinguishes between loving *to teach* mathematics versus *loving mathematics* itself. Is it possible that Zolani feels she has self-sacrificed more than the average teacher via her decision to come teach in a rural area? Is this feeling based on her urban childhood compared with Thandiswa and Simphiwe? Perhaps she had very high expectations of what she could achieve. Her last line... "I was confident then... but now I'm experienced" has a very cynical and sad undertone.
Z68	Zol-Initial	126	implicit	1	See Z65	the measure of a teacher's success is in their students' results	See also Z118
Z69	Zol-Initial	140	implicit	0	See Z67	a teachers' love for their subject is not affected by their students' results	Zolani seems to be saying that her love of teaching is waning, but not her love of her subject… even though in Z65 she says "I don't love it like I used to…".

Z70	Zol-Initial	146	explicit	0	Zol: So they… they are doing workshops for us. I'm getting more and more, but my learners?! Nuh-uh! I don't know, I don't know… I don't know what went wrong. Me: Are you feeling like there's just something happening in the community? That's just… Zol: Ya, man, they are not motivated. I don't think they like, if I may say, education. Ah man, they are not… they are not… into their learners' education, into their children's education neh. Me: They don't see learning and education as a means of improving themselves? Zol: Mm, mmm (agreeing) Even if you can go inside and just look… many of the teenagers are here doing nothing.	education is not a priority to rural communities	Zolani is frustrated by the disconnect between her level of training and her students' results. There is also an interesting connection between this discussion and Jansen's article about education no longer being perceived as a mechanism of escaping poverty. (Contrast with Fleisch. Also cite Green). When Zolani says they are 'doing nothing', does she mean that they are not trying (to find work i.e. by definition 'economically inactive') or that they attempts have failed? (The truth is probably a combination of the two. See Fleisch).
Z71	Zol-Initial	142	explicit	0	Zol: And I said 'yhu, I want to teach them! I want the rural kids to have this information.'	rural children do not get the opportunities that urban children do	
Z72	Zol-Initial	144	implicit	0	See Z67	inexperienced teachers are confident of their ability to make a difference. Experience will set them right (to be less naïve)	

Z73	Zol-Initial	152	implicit	1	Me: And do you find attendance in your classes can be problematic? Do they come to class? Zol: They come to class. They come to class—I have no problems with absenteeism. Me: That's good. Zol: But they are here, but just sitting Me: Sitting…doing… Zol: In most of the subjects, not even in maths. We have that problem here. I don't know how can you do it because they are losing interest. They are losing interest.	presence at school is not an indicator of dedication to learning	Zolani does not see presence at school as an indicator of dedication to learning. This may be the case, as free school feeding schemes provide alternative incentives to being at school besides the social mobility promised by learning. Also: not able to discuss this with Zolani, but perhaps if the learning does not result in social mobility, students do not see it as having any value (see prior comment about Fleisch, Jansen and Green). (this is a belief about what constitutes evidence of students' attitudes) Compare Zolani's comments about absenteeism with the headteacher's comments about turning around truancy at the school.
Z121	Zol-Initial	152	implicit	1	See Z73	Being present in school is an insufficient precondition to learning.	See Z73: this is a propositional belief about the preconditions necessary and sufficient for learning

Z74	Zol-Initial	156	implicit	0	Zol: They are losing interest. I rather have a new school, maybe if I get new learners, maybe they are tired of the same faces I don't know.	poor results can be due to a teacher being in the same school for too long	Z74 and Z75 are important beliefs as they reveal that: -Zolani is acutely aware that there is a problem -she is at a loss on what to do about it: she is considering quite trastic ideas such as changing schools for lack of any other alternatives (in her mind) Conceivably, therefore, she might attempt alternative teaching strategies if she were aware of those strategies and the complex nature of the problems she is faced with. Could increased training on reflective practice coupled with more social theory provide this?
Z75	Zol-Initial	156	implicit	0	See Z74	teachers need change and challenge in order to remain effective	this is a recurring theme in Zolani's interviews... she doesn't feel she knows what the problem is, and that she has tried what is in her repertoire without success. A sense of helplessness.

Z76	Zol-Initial	195	explicit	2	Me: Um, languages for example: do you think all languages are equal to each other? Zol: Mm-mm (no) Me: Why so? Zol: It's depending on, on the environment Me: ok? Zol: and which language they use mostly Me: ok Zol: and also they won't have the same value Me: value: so you think definitely how useful a language is Zol: but they are all useful! Me: yes, in some way /in some way/ Zol: /In some way/ ya, they are all useful in some way... because we are teaching in English, but we have to translate to their mother tongue	language usefulness and value is context-specific	This is quite insightful…
Z122	Zol-Initial	182	explicit	0	Zol: I'm not, I'm not a creative person…	affective (Zolani's beliefs about herself): Zol does not believe that she is a creative person	I think this also exposes a little bit of Zolani's low self esteem…
Z77	Zol-Initial	201	explicit	2	See Z76	all languages are useful	
Z78	Zol-Initial	203	explicit	4	See Z76	codeswitching into the MT is necessary in a rural school where English is LOLT	

Z79.1	Zol-Initial	207	explicit	4	Me: mmm. Mmm…and do you find that quite a difficult thing to do? The changing and translating and backward and forwards… Zol: because we do it most of the time, it's not difficult Me: ok Zol: ja, but I think sometimes we're using it very much, such that maybe they are very much dependent on us as a result, come the end of the year, they cannot cope on their own Me: ok Zol: because we have to translate the question papers Me: ok, so you think the code-switching doesn't foster their language development in English Zol: mm mm (no) that's what I'm saying	code-switching can create an unhealthy dependency on the teacher	Clear that CS is given a bit of a negative rap in the teacher training colleges. Almost like CS is "unfortunate, but necessary"
Z79.2	Zol-Initial		implicit	4	See Z79.1	Code-switching happens all the time as a normal part of classroom practice in schools like this.	
Z80	Zol-Initial	211	explicit	4	See Z79.1	code-switching hinders English development	
Z123	Zol-Initial	219	explicit	1	Me: and did they tell… did they say at the school if it was a good or a bad thing? Or did they just say 'you might have to code switch?' Zol: They say it's not good: you have not to overdo it Me: Mmm Zol: but you have to sometimes …sometimes cos they don't understand so you have to	CS is not good but necessary (Adler: dilemma)	
Z81.1	Zol-Initial	225	explicit	7	Zol: Ja, but in maths we don't use it (code-switching) Me: Not so much? Zol: Not so much because there are, there are terms that we don't have to translate in Xhosa	CS is less applicable in mathematics, where the terminology for the subject does not have equivalents in isiXhosa	

Z81.2	Zol-Initial		implicit		See Z81.1	Mathematics terminology stands on its own without being unpacked/explicated.	Am trying to say here that zolani does not believe mathematics words need further explaining and defining in everyday words. (Perhaps Zol1 observation with the confusion around the word 'opposite' highlights this and why she is caught out by the students confusion)
Z82	Zol-Initial	235	implicit	6	Me: Mm. What about words where they have one meaning in the maths classroom but another meaning outside? Zol: Like..mm.. (thinking) the ‘product’? Me: Like ‘product’! Zol: The ‘product’, ya, like in the ‘difference’ Me: ‘difference’! Zol: Ewe, ah, ya! (seems to have had a realisation) we usually have a problem there and then you have to explain them that this is a maths class so you have to think mathematically!	thinking "mathematically" is the difference between the mathematical use of a word compared to its everyday use.	Really not clear what 'thinking mathematically' means: bit of a tautologous response "you're in maths class therefore you must think mathematically".
Z83.1	Zol-Initial	239	explicit	7	Me: Ok. Um, and in terms of the language—you say you don’t code switch so much—do you use what you have available or do you try and model grammatically good Xhosa, grammatically good English? Or do you just kinda say ‘you know what, let’s get on with it and focus on maths!’ Zol: Mm… sometimes you have to model good grammatical… depending man on the topic you’re doing. Some topics need you to be deep in code-switching.	some topics require more CS than others	

Z83.2	Zol-Initial		implicit	4	See Z83.1	One can't model good language and code-switch at the same time	This belief along with Z81.1 indicate that to Zolani code-swtiching has a very particular grammatical form and structure. In the observations, most of Zolani's code-switching was intersentential switching between matrix languages with discourse specific terminology being inserted in English into a Xhosa matrix language or Xhosalized words being inserted into an English matrix language.
Z84.1	Zol-Initial	239	explicit	7	See Z83.1	Modelling good language can be a hindrance to learning	
Z84.2	Zol-Initial		implicit	2	See Z83.1	code-switching and good grammatical language are mutually exclusive to each other.	This is the crux of beliefs from Z82 to Z84
Z85	Zol-Initial	240	explicit	2	Me: I mean, I'm hearing some English in the village, but not many people speak… Zol: not many people speak English… Me: …English Zol: ja Me: certainly not to a native proficiency as like a mother-tongue speaker. They have a little bit to get by, Zol: ja, Me: ja Zol: And the problem is most of the parents here are illiterate. Me: Really? Zol: So they cannot read or write… Me: ok Zol: so… so it's Xhosa all the way at home.	students do not have many English role-models	Zolani went on to say that many of the parents/grandparents are illiterate so there is no reading or writing in the home. This belief also speaks further to the role of teachers as role models of English. But by her own admission, Zolani's spoken English is not strong. This is particularly interesting given that, even though most of the teachers expressed greater confidence in their written versus their spoken English, very little writing occured in class esp. the Gr9 English class I observed. most of the homes I visited (e.g. Lungelwa) were print scarce.

Z86	Zol-Initial	261-263	explicit	0	Zol: And you are headed by a grandmother, and the grandmother is very old sometimes, you can do whatever! Me: mm Zol: She cannot help you with the homework, you can go wherever you want to go! The grandmother don't worry you. Because young parents can make sure that the children have done the homework. Make sure that "my children… are you through with your homework? Ok, you can watch TV now." They watch TV all the time, and go out all the time…	grand-parent led households are less disciplined	Fleisch mentions this too. Compare this with Nkulie's comments from the journal.
Z87	Zol-Initial	261	explicit	0	Me: Ya… um, some people have been saying as well that there's a lot of grandparent or child-led households? Zol: Mm (yes) Me: You know, the parents being away to work… Zol: Yeah, they are at Cape Town, most of the parents here. They (the students) are living with their grandparents Me: Ok, and do you think… do you think that might be part of the problem? Zol: It's a part of the problem … it's really the part of the problem because kaloku, you are the head of the household, you are a learner, you have to look for your siblings also… there's a lot.	many children have other burdens as carers	Again, reference Fleisch. See student surveys for further data. Also: this exchange does not exploed how many students have sickly parents (HIV)
Z88	Zol-Initial	265	prompted	4	Me: do you think it's better to use as much English as possible when teaching maths? Is it better for them? Zol: It's better. It's better. It's better, it's better. Even if, sometimes you see that they don't understand, but at the end, if you keep on, keep on talking English with them they will understand.	English can be learnt by just continuously insisting on talking to the students in English	Zolani's model of language learning is premised on simply being talked "to" instead of using the language… i.e. understanding without production. *Any literature on this as 2LA technique?* This also contradicts her earlier statements about code-switching to get them to understand (she inferred that if you don't code-swtich, they won't understand). here, the strategy of repetition is being put forward as the mechanism of fostering understanding.

Z89	Zol-Initial	271	implicit	0	Me: Do they have any dictionaries at all? Zol: They have, they have dictionaries. Me: Ok Zol: The school has bought some dictionaries for them… Me: …ok… Zol: …and also forcing them to buy dictionaries, they're encouraging them to buy them. Me: Ah ok, and do they buy them? Zol: Some of them. Some of them.	It is not unreasonable to insist that students coming from households dependent on child grants and pensions should buy school resources such as dictionaries (and later, calculators)	This statement by Zolani strikes me as a crazy expectation! What can be deduced from this? Is Zolani out of touch with the socio-economic realities of her students? OR is she concerned I will think ill of her if the students do not have dictionaries and hence attempts to convince me that she has attempted all possible avenues to get the students dictionaries. (only saw one student in Grade 8 with a dictionary).
Z90	Zol-Initial	277	explicit	0	Me: any other problems you can think of that come up? Zol: Ah… I don't think they will have much of a problem with language because these learners at least… but they are not dedicated! That is the problem! Me: It's the application? Zol: you have to be serious with your work! In whatever you do, even if you want to draw! You have to focus on that! Uyabon'? (You see?) So they are not focused.	The problem with the learners at THIS school is not language, it is work ethic	This belief really sums up my findings! 1) the lack of work ethic is the source of the students woes. 2) Other issues are dicarded/not considered as a result 3) From Zolani's point of view, my Venn diagram should have the "language" bubble not overlapping the others at all.

Z91	Zol-Initial	279	explicit	0	See Z90	The students at the school are not focused	this is a frequent lament: suspect that 'not focused' and 'lazy' are synonymous in Zol's case.
Z93	Zol-Initial	293, 289	explicit	0	Zol: They are losing focus. There would be no problem ... they are not cooperating. We tried, one time, I don't know which year, saying that in the school yard, everybody must speak English, because we saw that there's a problem with language, so everyone in the school yard, but yho! They were not cooperating. Me: mmm Zol: Uyabon'? (You see?) There's no discipline (becomes quite animated) It's not easy to learn to be a good student when there's... you don't have i-discipline. Me: mm mm Zol: you have to be disciplined!	The students at the school are defiant	This is obviously a VERY strong belief with Zolani! Need to highlight this on her beliefs map!
Z94	Zol-Initial	281	implicit	4	See Z93	Students can learn English by being made to speak it instead of isiXhosa	
Z95	Zol-Initial	283	explicit	0	See Z90	The students at the school are not disciplined	Zolani's notion of 'discipline' seems quite punative and narrow.

Z96	Zol-Initial	285, 349	explicit	1	See Z93	Discipline is the core factor that distinguishes educational success from failure	Although there can be little doubt that "discipline" (or at least what Zolani referes to as "discipline", namely doing homework everyday, practicing, trying every question in the book, *doing as you're told)* is productive and probably a necessary precondition to educational 'success' for most learners (although there are always exceptions, and what constitutes 'educational success' is more a result of the system itself, rather than the theoretical ideals the system purports to achieve). Zolani seems to believe that not only is "discipline" a necessary precondition, but that it is also sufficient! This is quite a fundamental proposition in her philosophy of education.
Z97	Zol-Initial	303, 335, 341	implicit	3	Zol: They must know that the subject of the formula must be alone on it's side, neh Zol: How? They must know this (pointing to '4b') is multiplying, uyabon'? Zol: so they hve to divide. If it was dividing, so they have to multiply. If it was added, they have to subtract it. Both sides! Me: Mm! Ok! Zol: What you do this side, you have to do on the /other side also/	mathematical facts are discrete entities to be memorized	"4b" means "multiply": this is mathematics *convention* and must be learnt. Her whole description is very procedural... I need to back this up with further evidence from the observation data.
Z98	Zol-Initial	303	implicit	3	Zol: They must know that the subject of the formula must be alone on it's side, neh	the mathematical idea of the 'subject of the formula' is based on the visual arrangment of the expression, not on the semantics of the symbols	Draw further here on the vignette from Zol1 to substantiate this observation. Also refer to work by Zain Davis?

Z99	Zol-Initial	305	implicit	3	Zol: it must be the head, uyabon'? | …as the subject of the formula. It is leading this formula: everything is equal to 'a'!	mathematics can be described with metaphors	this is particularly interesting as it is predicated on a reading of 'left to right'
Z100	Zol-Initial	327	implicit	7	Me: What do they do? Zol: /... when they don't understand/. But: they must know the question when it says 'solve'.	there are keywords to identify in maths questions which indicate the *process* to be instigated	
Z101	Zol-Initial	315, 333, 339, 341	implicit	3	Zol: on the other side! The only one on this side. U-'a' abe yedwa this side! All these must be equal to 'a'! so what you have to do? You have to remove all these and you are left with 'a'. Zol: 'b' must be the subject of the formula, and then they must know that, they must remove everything which is attached to u-b. Zol: so they hve to divide. If it was dividing, so they have to multiply. If it was added, they have to subtract it. Both sides! Zol: What you do this side, you have to do on the /other side also/	mathematics is procedural	most of Zolani's description around the example given involves "doing things to" the expression to yield the desired result. The expression is an object to be acted upon
Z102	Zol-Initial	347	explicit	6	Me: if a student comes to you and says 'ma, ndifuna ukuphumelele ngezibalo zam!' (Mama, I want to succeed at my mathematics), what do you say to them? "Well these are things you must do.. to succeed, to be a good maths student" Zol: Oh, to be a… I, I, I always tell them that if you want to… to do maths, number one, you have to love it! You have to love mathematics! Don't just do it! Love it! Me: Mmhmm Zol: And then you practice, practice, practice every day: not even a day goes by without practicing. You have to practice… (be) dedicated, attend every day, listen, cooperate, then you will never go wrong. Yes!	success at mathematics as a school subject is predicated on loving the subject (affective belief)	Refer to Fleisch here (and Cape Town TV "Voices" episode from Monday the 10th of December prior to the Al Jazeera news at 8pm). See Z96

Z103	Zol-Initial	349	explicit	1	See Z102	cooperation with the teacher is a critical feature of a successful learner	
Z104	Zol-Initial	349, 351	explicit	6	Zol: Ya, lots and lots of prac… if, if I've given them one.. "do this for homework, (numbers) 1 and 2" then you have to do all of them! Also see Z102 & Z96	learning of mathematics requires hours of drilling and practice	Successful students go 'above and beyond'.
Z105	Zol-Initial	353	implicit	6	Zol: Because you love maths (and) you want to go somewhere..	mathematics is a mechanism of mobility	
Z106	Zol-Initial	353	explicit	6	Zol: …and then when you come to me, "Miss, I've done…" I, I, we had a student like that. Me: yeah? Zol: one year… Me: yes? Zol: oh! He was very challenging: Uthe 'Miss, I was doing number 10… I know you gave us to number 5, but I was doing number 10: can you please do it on the board?" Taking all the challenging… Me: proactive hey? Zol: yeah, oh, I had to prepare everything! Me: But, did you like that? Zol: I liked it!	a good student is one who does lots of questions from the textbook	How does this inform beliefs Z26.1-Z28? About the public posturing of strong students compared to the public shaming of weak ones?
Z107	Zol-Initial	375	explicit	0	Zol: Hayi, there's no love oh! For maths? Me: Mmm. There's no /energy hey?/ Zol: /In a class,/ in a class of about twenty-nine you'll find that only three can manage. Me: Mm! really? Zol: /only three/ ya, only three	students these days do not enjoy mathematics	There seems to be a conflation between 'loving'/enjoying mathematics and understanding it
Z108	Zol-Initial	391	led	3	Me: do you think that maths builds up from the bottom? Zol: yes.	mathematics is a cumulative subject	

Z109	Zol-Initial	397	explicit	0	Zol: /the problem/ here is, is the stage… Me: mm? Zol: the teenage stage. Once they reach that stage they want to lose focus Me: mmm Zol: they are interested in, in, in other things, other than learning, uyabon? (you see?)	teenagers are not dedicated to learning OR the teenage years are particularly problematic as far as learning is concerned.	Zolani basic infers that hormones and wanting to date and engage in courting relationships is a major distraction for teenagers (and she's right!). However, whether one is focused on partners OR focused on school is questionable?
Z110	Zol-Initial	405	explicit	0	Zol: ayi they.. ah, ah… maybe the, the community doesn't like teachers because, hey we don't feel protected. They don't love us. Me: really? Zol: Ooh, ah-ah (no way). Me: Have you had experiences with the community where you felt really under fire? Zol: Not as such, not as such, but you can the learners, that, ey, these learners, mm mm… Me: You just feel like they are not pulling with you? They are not on your side? Zol: They are not on our side! Me: ok Zol: They are not on our side. Me: So it's not so much against you, but they are just not with you Zol: ja!	this community does not like teachers	This contrasts interestingly with comments made by teachers, recorded in my journal about how the teachers view the community. Zolani here seems to infer that the attitude of the learners is a good representation of the attitude of the community in general. Would've been interesting to follow this up with more discussion about the nature and frequency of parent-teacher interactions and relations (see interview with the head teacher).
Z111	Zol-Initial	413, 418	implicit	1	See Z110	teachers cannot educate students on their own: they need cooperation from the students and the supporting community	
Z112	Zol-Initial	419	prompted	4	Me: .. what do you think is the most difficult thing you have to teach to the grade 10s? where do you see them having the most problems? Is there anything that you think to yourself "oh my word, it's that time of the year: I have to teach this topic. I hate teaching this topic because they always find it difficult!" Zol: Yoh! It's trigonometry.	These students find trigonometry very difficult	This summarizes nicely the confusion Zolani experiences.

Z124	Zol-Initial	423	explicit	6	Zol: Yah, it's trigonometry Me: they just don't…all the /ratios/… Zol: /I,I/, I don't know why because… I don't think it's a very difficult topic.	Trigonometry is not difficult	
Z113	Zol-Initial	429	prompted	4	Me: Do they, do they depend on their calculators /very heavily?/ Zol: /They depend very heavily/ Ja… sometimes they cannot even subtract four from eight because they have (reaches for the calculator) "eight minus four!"… you see!	students depend very heavily on calculators	
Z114	Zol-Initial	430-435	led	7	Me: do you think that, do you think that English is better suited to teaching and learning maths than Xhosa? Because of those words you were /speaking about earlier?/ Zol: Ayi, it's better teaching in English Me: In English… Zol: ya, you can use Xhosa just a little bit Me: …just a little bit… but English is certainly more suitable? Zol: it's more suitable	English is more suitable for teaching mathematics than isiXhosa	

Z115	Zol-Initial	439	led	6	Me: Do you think it's more difficult to talk about mathematics than to talk about, say… Geography! Or Travel and Tourism? Zol: I think it's difficult to talk about mathematics Me: Really? Why so? Zol: Maybe it's the terms? They don't understand? Maybe, because it's mathematics… ay, I'm not sure why, it's not easy—they understand Tourism easier Me: mm Zol: Maybe it's because it's around them? Me: Ok? Zol: More… Me: Something more with context, that they can.. Zol: ya Me: relate to? 'cos Maths is very context… removed Zol: yes Me: ya? You can't see trigonometry in the grass Zol: Ja! Maybe that is the problem?	it's difficult to talk about mathematics	Zolani came up with the initial idea that Tourism is easier because it's context specific and hence easy to see. My further suggestions were an attempt to clarify her point as it related to mathematics. Again, she is thinking aloud and postulating what the problem could be… this is a particularly insightful and lucid hypothesis (context-embedded versus context-reduced). General note: it would be good to conclude by drawing on these gems from each teacher where they indicate the potential for further development that is not being harnessed.
Z116	Zol-Initial	443	explicit	1	See Z115	students understand things that are context-rich better	
Z117	Zol-Initial	455	explicit	6	Zol: it's not easy. But ke, if you get people who love it, then at least it's easy.	mathematics is easy if you love it	affective and causal!
Z118	Zol-Initial	459	explicit	0	Zol: ya, I loved it, and I wanted to produce, but now that I'm not producing…I, I don't think I still love it. But, ke, I, I do…	enjoying your work as a teacher is dependent on 'producing' good results	same as Z68

Z119	Zol-Initial	465, 467	explicit	0	Zol: (despairing) hayi, but… eh, learners of today! Ah-ah, before they were not like this. Every day, every day, maybe our learners are having challenges.. they, there are challenges… Me: Mmm… ya, in some ways, well, one can feel sorry for their position.. as teenagers. Zol: Mm, I feel sorry for them… there are many, many challenges—they've got many challenges.	teenagers nowadays face exceptional challenges	Zolani does not explicit what challenges she means, although she has alluded somewhat to a mix of 'challenges', some imposed (younger siblings, grandparent led households etc.) and some invited (phones, relationships etc.). She is also very openly nostalgic and romanticizes her own school years. Should refer to Speer 2005 here as I am not sure that what I mean by 'challenges' is the same thing as what Zolani means!!
Z120	Zol-Initial	469 471	explicit	1	Zol: And immediately you get out of class, they close their books, you will see they have… we, we didn't have phones. They have phones! Me: Mm Zol: They are always on Facebook, MXiT	technology is a distraction from studies	How does this relate to what Zolani refers to as 'discipline'?